APRIL, 1933.

GENERAL PHYSICS.

ADSORPTION.

1245. Linear Phenomena. Part I. D. L. Talmud, B. A. Talmud and S. E. Bresler. *Zeits. f. phys. Chem.* 163. *Abt. A.* 2. *pp.* 91–106, *Jan.*, 1933.—Linear wetting phenomena are described which occur at the boundary lines of three phases, and the conditions for linear wetting are derived. A process for the quantitative measurement of linear adsorption has been found which based on the fact that the linear active substance, which is deposited on the surface of a lyophylic colloidal solution or upon the unsaturated film of an insoluble lyophylic colloid, forms a monomolecular adsorption thread upon the boundary line micelle/water/air; the micelles are insoluble and the surface pressure can be measured which they exert upon the Langmuir balance. The linear adsorption is measured of cetyl alcohol and of paraffin upon the surface of tannin solutions, of cetyl alcohol upon the surface of agar-agar solutions, and also of myristic acid and of cetyl alcohol upon unsaturated films of ethyl cellulose. A method is described for the determination of the average magnitude of the micelle diameter and of the micellar weight of lyophylic colloids by means of the linear adsorption data. H. H. Ho.

1246. Equilibrium of Atoms and Ions Adsorbed on a Metal Surface. R. C. Evans. *Cambridge Phil. Soc., Proc.* 29. *pp.* 161–164, *Jan.* 31, 1933.—The theory of the evaporation of adsorbed atoms and ions of alkali metals from a hot metal surface as developed by Becker [see Abstract 1622 (1930)] has been extended to take account of the rate of attainment of equilibrium on the surface. F. J. W.

1247. Separation of Very Small Quantities of Substances on Crystallising Precipitates. R. Mumbrauer. *Zeits. f. phys. Chem.* 163. *Abt. A.* 2. *pp.* 142–154, *Jan.*, 1933.—The adsorptive co-precipitation, on precipitates crystallising out, of ions not present in the lattice, is determined largely by the possibility of these ions being displaced by ions of the lattice, the important factors in this connection being the velocity of crystallisation, the solubility of the adsorptive compound, the magnitudes of the ions, and the polarising properties of the foreign ions to be adsorbed. In the case of very sparingly soluble adsorptive compounds and for ions with marked polarising properties, adsorption of the foreign ions may occur in accordance with the requirements of Hahn's adsorption law when the precipitate carries a similar charge. For the co-precipitation of very small amounts of substances on crystallising precipitates, the experimental data confirm Hahn's limitation of the mixed-crystal structure by the adsorption. T. H. P.

1248. Improved Method for the Determination of Isothermals by the Retentivity Technique. L. J. Burrage. *J. Phys. Chem.* 37. *pp.* 33–39, *Jan.*, 1933.—An improved technique for the determination of adsorption isothermals is described. The isotherms are found to consist of a series of rectangular steps in the adsorption of water vapour by charcoal, and carbon tetrachloride and water vapour by silica gel.
F. J. W.

1249. Discontinuities in the Sorption Process. L. J. Burrage. *J. Phys. Chem.* 37. *pp.* 41–45, *Jan.*, 1933.—Sorption isothermals are shown to consist of a series of rectangular steps similar to desorption isothermals. The system investigated is water-charcoal. F. J. W.

1250. Sorption of Water Vapour by Glass. E. P. Barrett and A. W. Gauger. *J. Phys. Chem.* 37. *pp.* 47–51, *Jan.*, 1933.—A test has been made of the rectilinear character of the logarithmic form of the sorption isotherm for the system water-glass over a range of relative humidities from 10^{-3} to $3 \cdot 10^{-2}$. F. J. W.

See also Abstracts 1353, 1354, 1556, 1559.

ATOMIC AND MOLECULAR STRUCTURE.

1251. Chemical Bond. G. N. Lewis. *J. Chem. Phys.* 1. *pp.* 17–28, *Jan.*, 1933.—After a brief introduction, which includes the remark that in the Schrödinger equation there is almost *the* mathematical foundation for the solution of the whole problem of atomic and molecular structure, the author discusses the problems of structural framework, of pairs and bonds, of the steric implications of the octet, of the molecule with complete electronic shells, and finally of molecules with incomplete shells. With respect to the interpretation of molecular spectra, the author suggests that the molecule of completed shells should be taken as a norm, assigning each electron orbit to a given atom, or to a given bond between two atoms; from the norm, and symmetrically in both directions, the discussion should deal first with cases where one electron is in excess or one electron is lacking, then to the case where two electrons are in excess or lacking, and an attempt should be made to assign these electron excesses or deficiencies to individual atoms. The author believes that the study of such systems is the greatest field for the future development of chemistry and spectroscopy alike. H. H. Ho.

1252. Relative Abundance of the Carbon Isotope, C^{13}. F. A. Jenkins and L. S. Ornstein. *K. Akad. Amsterdam, Proc.* 33. 10. *pp.* 1212–1219, 1932.—The relative intensity of the 1·0 band of $C^{12}C^{13}$ to that of $C^{12}C^{12}$ is measured by photographic methods for four different sources, and found to be effectively constant, its most probable value being $0 \cdot 019 \pm 0 \cdot 002$. Reasons are given why the isotope band is not observed in the carbon arc in air. The presence of lines due to $C^{13}N$ in the λ 3883 CN band from the arc in air is established. The above intensity ratio corresponds to an abundance of 1 to 106, giving an atomic weight definitely higher than the accepted chemical value. H. H. Ho.

1253. Lead Isotopes. Edna R. Bishop, Margaret Lawrenz and C. B. Dollins. *Phys. Rev.* 43. *pp.* 43–46, *Jan.* 1, 1933.—The magneto-optic method [see Abstract 807 (1931)] shows that lead has sixteen isotopes of probable mass and order of abundance 208, 206, 207, 205, 212, 210, 204, 202, 203, 211, 201, 209, 216, 215, 214 and 213. All sixteen isotopes of lead were found in c.p. uranium and thorium salts. 206, 210, 202 and 214 predominated in uranium salts, while 208, 216, 204 and 212 predominated in thorium salts. The differential time lag varies directly with the weight of the isotopes of a given element. The amount of isotope present is some unknown inverse function of the concentration necessary to read its minimum so that the order of appearance of minima gives the order of abundance but not the relative abundance of isotopes. The order of abundance of isotopes is also given by the amount of rotation of the analysing nicol necessary to extinguish their minima. AUTHORS.

1254. Bismuth Isotopes. F. Allison and Edna R. Bishop. *Phys. Rev.* 43. *p.* 47, *Jan.* 1, 1933.—The magneto-optic method [see Abstract 807 (1931)] shows that bismuth has fourteen isotopes. AUTHORS.

1255. Radium Isotopes. Edna R. Bishop and C. B. Dollins. *Phys. Rev.* 43. *p.* 48, *Jan.* 1, 1933.—The magneto-optic method [see Abstract 807 (1931)] shows that radium has four isotopes. The probable masses in order of decreasing abundance are 226, 228, 230 and 232. AUTHORS.

1256. Isotopes of Uranium, Thorium and Thallium. R. Goslin and F. Allison. *Phys. Rev.* 43. *pp.* 49–50, *Jan.* 1, 1933.—The magneto-optic method [see Abstract 807 (1931)] shows eight isotopes each for uranium, thorium and thallium. AUTHORS.

1257. Zero Point Energy and Separation of Isotopes. H. Eyring. *Nat. Acad. Sci., Proc.* 19. *pp.* 78–81, *Jan.*, 1933.—Washburn and Urey [see Abstract 4712 (1932)] have shown that, as water is electrolysed, the residual portion grows richer in H^2. The effect of the zero point energy on reaction rates is now discussed [see Abstract 2864 (1931)], and it is shown that the greater zero point energy of the lighter isotope effectually aids it in passing over the potential barriers in the surface reaction $2H^+ + 2$ electrons $= H_2$. The process is regarded as separated into two steps, in the first of which the hydrogen ion gains an electron and then becomes attached to the surface. The second step corresponds with the approach of two of these attached hydrogen atoms so that a bond forms between them while the bond to the two surface atoms becomes continuously weaker. This second step is simply the reverse of an adsorption process and has been discussed in detail from the point of view of quantum mechanics [see Abstract 4640 (1932)]. T. H. P.

1258. Researches upon the Isotopes of Oxygen, Neon and Chlorine. H. Kallmann and W. Lasareff. *Zeits. f. Physik*, 80. 3–4. *pp.* 237–241, *Jan.* 23, 1933.—The authors have developed a mass spectrograph with which they can distinguish intensity ratios of the order of 1000 : 1 and have used it to determine the relative amounts of the isotopes of oxygen, neon and chlorine which are normally present. They show that the form of the " line " produced in the spectrograph is constant and that relative amounts of the isotopes may be inferred safely from the maximum intensities of the lines. The oxygen isotopes O^{16} and O^{18} were investigated using CO, H_2O and oxygen for the purpose. The ratio of O^{16} to O^{18} was found to be 600 : 1, 650 : 1 and 630 : 1 respectively, giving a mean value which agrees well with that obtained by other experimenters. For neon the ratios $Ne^{20} : Ne^{21} : Ne^{22}$ were found to be 93·7 : 1 : 9·75, being in good agreement with spectroscopic values. Chlorine was investigated as the element and as HCl and the ratios $Cl^{39} : Cl^{37} : Cl^{35}$ are given as 1 : 1850 : 6000, no evidence of Cl^{38} being found. J. E. R. C.

1259. Quantic Theories of Valency. G. dalla Noce. *N. Cimento, (Rivista)*, 9. *pp.* 185–203, *Dec.*, 1932.—A review of present knowledge of the subject, considered under the headings: Generalities on polar and homopolar forces; electronic structure of the molecules and valency; Heitler and London's theory of homopolar valency for diatomic molecules; application of the theory of valency spin to diatomic compounds; orbital valency; excited states and homopolar theory; valency and pluriatomic molecules according to Heitler, Rumer, and Weyl; valency theories of Slater and Pauling, Hund, Mulliken and Herzberg; pluriatomic molecules and molecular orbits; Hund's classification of valencies and linkings; molecular orbits and organic chemistry; theories of valency and polarisation. T. H. P.

1260. Symmetry of the Benzene Molecule. V. Deitz and D. H. Andrews. *J. Chem. Phys.* 1. *pp.* 62–66, *Jan.*, 1933.—The melting points of various isomeric organic compounds indicate that molecular symmetry has an important effect on physical properties. With R. H. Fowler's statistical treatment of the crystal state, the symmetry number has been calculated for benzene and cyclohexene. The data employed are the vapour pressure, the heat capacity of the crystal, the heat capacity of the vapour as calculated from Raman spectra, the heat of sublimation and the moments of inertia. According to this calculation the symmetry number for benzene has the value $6 \pm 0{\cdot}5$ indicating that the molecule is not plane. The symmetry number for cyclohexene is $2 \pm 0{\cdot}2$ as is to be expected. AUTHORS.

1261. Comparison of the Masses of He and H^1 on a Mass-Spectrograph. K. T. Bainbridge. *Phys. Rev.* 43. *pp.* 103–104, *Jan.* 15, 1933.—The ratio of the masses of He and H^1 was measured by comparison of He^{++} with H_2^{1+} on fourteen spectra, and the measurements give $He : H^1 = 3{\cdot}971283 \pm 0{\cdot}000042$. If $He = 4{\cdot}00216 \pm 0{\cdot}00013$ on the O^{16} scale as given by Aston, then $H^1 = 1{\cdot}007775 \pm 0{\cdot}000035$ in excellent agreement with the value 1·00778 reported by Aston. A method is suggested for the determination of the mass of H^2 in terms of He and C. AUTHOR.

See also Abstracts 1293, 1305, 1407, 1408, 1426, 1487, 1500, 1506, 1507.

COLLOIDS.

1262. Measurement of the Velocity of Gold Micelles by Observation of the Moving Boundary. W. Hacker. *Kolloid Zeits.* 62. *pp.* 66–76, *Jan.*, 1933.—Simultaneous measurements of the cataphoretic transference velocity of colloidal gold particles by the moving boundary method and by colorimetric determination of the actual quantity of gold transferred gave concordant results. The moving boundary method is thus suitable for such measurements with solutions of negligible specific conductivity. H. F. G.

1263. Laws of Swelling. J. R. Katz. *Faraday Soc., Trans.* 29. *pp.* 279–298; *Disc.*, 298–300, *Jan.*, 1933.—A critical discussion of the phenomenon of colloidal swelling and the laws which are entailed. The phenomenon is characterised under three headings which are defined and studies, namely, intermicellar, intramicellar, and permutoid. The cases are differentiated with the aid of X-ray analysis. The heat of imbibition and volume contraction as also the mechanical properties of the solid before and after swelling are discussed fully. The paper constitutes a complete and thorough review of the subject. In the *Discussion*, **J. B. Speakman** pointed out that the swelling of wool was mainly intermicellar, but all three forms of swelling were present; **G. F. Davidson** suggested that the difficulty of definition of the true volume of a solid could be got over by making specific volume measurements with helium as the immersion medium; this had been successfully applied to wood; **W. W. Barkas** also discussed the specific volume of wood; **Miles** raised the matter of nitrocellulose, pointed out that in acetone water both intramicellar and permutoid swelling occur, and referred to X-ray data in support; **H. Staudinger** stated that synthetic products of well-known molecular structure such as polystyrols had yielded results showing that swelling phenomena increase with increase in the degree of polymerisation. S. G. B.

1264. Action of Boundary-Surface Active Substances on the Formation of Crystals in Liesegang's Rings. Part III. Action of Adsorption Layers on the Disperse System. Nadine Serb-Serbina. *Kolloid Zeits.* 62. *pp.* 79–85, *Jan.*, 1933.—It is pointed out that boundary surface active substances can be divided into two classes with respect to their action on the formation of crystals in periodic layers: (1) There are the molecularly soluble typical boundary-surface active substances in the energetic sense, as *e.g.* alcohol, amine, phenol. These leave the crystal form unchanged; they increase however the degree of dispersion of the system, while they decrease the rate of crystallisation. As they increase the permanent supersaturation of the solution, it follows that they strongly lessen the distance between the rings. (2) To the surface active substances of the second group belong the hydrophylic protective colloids (gelatin, saponine, etc.) which build a strongly hydrated adsorption film and materially alter the crystalline form. They also lessen the distance between the rings. The action of sodium eosin which alters the crystal form but shows irregularly-arranged rings, is to receive further study. Eosin probably belongs to the surface active substances of the second class or lies halfway between the two classes. [For Part II see Abstract 1395 (1931).] J. K.

1265. Causes of Thixotropy of Certain Sols. P. Bary. *Comptes Rendus,* 196. *pp.* 183–184, *Jan.* 16, 1933.—Thixotropic sols of the type of ferric oxide are envisaged as structures of hydrophobic granules of the solute bound together by hydrophilic solute polymerised into chains. A. S. C. L.

1266. Molecular Aggregation of Nitrocellulose. F. D. Miles. *Faraday Soc., Trans.* 29. *pp.* 110–121, *Jan.*, 1933.—The formation and structural properties of the nitrocelluloses, except perhaps those of less than 7·5 % or more than 12·8 % nitrogen content, are accounted for by a consideration of the effect upon the long chain molecules of the intracellular process which ensues during nitration. Nitrations to less than 7·5 % are explained as heterogeneous reactions at the internal surface, and remembering the facility of penetration of the cellulose structure by nitric acid, these reactions are possibly intramicellar. In the range 7·5 to 12·8 % nitration is accompanied normally by fibre disintegration and high absorption of nitric acid, explained as effects of variation of the degree of nitration of the single chain. The data are explained upon the assumption that all the chain molecules are approximately nitrated to the same extent so that the chance of trinitration of any individual is small. The micellar theory of nitration, whereby the nitrocellulose consists of cellulose micelles each nitrated to trinitrate in a peripheral layer is against the experimental and other evidence. S. G. B.

1267. Structural Variations in the Nitrocelluloses. M. Mathieu. *Faraday Soc., Trans.* 29. *pp.* 122–131, *Jan.,* 1933.—The structure of nitrocellulose in the fibrous state changes with the degree of nitration. The elementary glucose residue chains remain separated at well-defined distances which vary with the nitrogen content. On the other hand apparently the nitrate groups are distributed at random along the chains, strict regularity tending to reappear as full trinitration is approached. The solvent primarily acts as a swelling agent and later as a dispersing agent; thus molecular chains are dispersed. X-ray photographs obtained upon drying show that on drying, the dispersion is greater according to the greater solubility of the nitrated cotton in the solvent. For a given nitrocellulose the dispersion increases with the dilution. The autoclave causes fractionation of the elementary chains of the glucose residues of nitrocelluloses. The length of the linear elements which constitute the chains determines the viscosity of a solution of given concentration. A kind of recrystallisation of the cellulose substance, *i.e.* a more regular grouping of the chains in the structure of the film, is created by drying at temperatures higher than the ordinary. S. G. B.

1268. Constitution of the Keratin Molecule. J. B. Speakman and Mercia C. Hirst. *Faraday Soc., Trans.* 29. *pp.* 148–164; *Disc.,* 164–172, *Jan.,* 1933.—The micelles of the wool fibre consist of long peptide chains bridged across by salt linkages on the one hand and cystine on the other, the former being probably of glutamic or aspartic acid and arginine lysine or hystidine. The consequences of such a structure are reviewed in the light of extensibility, water absorption, dyeing properties, and swelling, etc. Amino acid identification is of paramount importance in future work. Wool has not an isoelectric point but a range. In the *Discussion,* **E. Elod** stated that the isoelectric point of wool is at pH 4·9, and even after prolonged investigation equilibrium is obtained at this value, minimum reaction capacity and swelling also occur here, and the presence of basic wool proteins, such as arginine and lysine to the amount of 10 % is inadequate to explain the existence of the Speakman isoelectric range from pH5 to pH7; **W. T. Astbury** mentioned that the keratin of animal hairs exists in two forms: (1) in which the polypeptide chains are folded, and (2) in which they are extended into a straight configuration. In wool the transition is reversible; a common feature of both forms is that the larger side spacing is the same for both types; the paper states that the electro-positive centres of the basic side chains are linked across in salt linkage with the electro-negative centres of the acidic side chains, but since the two types of side chain are nearly equal in relative proportions, X-ray evidence would indicate that not only do the charged centres approach as closely as possible laterally, but also longitudinally; **D. J. Lloyd** pointed out that with gelatin gels and collagen fibres drying diminishes swelling capacity, and possibly electrovalent linkages which are theoretically extensible may be converted into inextensible covalent linkages; **T. R. Bolam** regarded the application of the Proctor Wilson theory by the authors as inadequate, since according thereto the osmotic pressure is the force producing swelling, and, other things being equal, it follows that the maximum amount of swelling in wool fibre should be identical for all monobasic acids; statements made therefore as to the swelling in formic acid need further elucidation; **R. A. Peters** pointed out that the possibility of salt linkages playing a significant part in protein structure had not been rejected and referred to Sorensen and Cohn, etc., the view that salt linkages between groups other than the α amino and associated carboxyl exist in wool does not necessarily follow from the data. The facts rather point to the action of acid and alkali as titrating the – COOH and α NH_2 groups of the " Zwitterion " ; this also explains the isoelectric region as due to chemical combination – CONH – linkage of the terminal – COOH and NH_2 groups ; **S. M. Neale** stated that the isoelectric region finds a parallel in the swelling of cellulose in caustic alkalies ; **J. B. Speakman** replied to criticisms : Bolam's contention is valid only for gelatin, Elod's work is largely in agreement ; and Peters' criticism is met by a table of analyses of egg albumen by Calvery. S. G. B.

1269. Surface Films of Cellulose Derivatives of Aqueous Solutions. N. K. Adam. *Faraday Soc., Trans.* 29. *pp.* 90–99 ; *Disc.*, 100–110, *Jan.*, 1933.—The spreading of methyl, ethyl and benzyl ethers of cellulose, of cellulose nitrates, acetates and esters with other fatty acids up to 18 carbon atoms in length is studied by means of surface measurements of pressure and area and by ultramicroscopic examination of the films. The ethers spread completely upon water, and the esters incompletely to films of one glucose group in thickness. On NaOH the esters spread almost completely on double normal solution, whilst on this solution nitrates containing excess of approximately 12·6 % of nitrogen spread incompletely. The pressure/area curves of the films are similar in form in the various cases, above about 2 dynes/cm. The results indicate that (*a*) the chains lie with every glucose ring nearly flat on the water, (*b*) the chains are flexible and may vibrate vigorously (and at low compressions in the plane of the water surface), and (*c*) the differences in the facility for spreading between different derivatives are due (1) to the lateral adhesion of the esterified or ether groups to the water and (2) the lateral adhesion between the chains in the solutions of the cellulose derivatives. Except possibly in cellulose itself, no micelles or bundles of parallel chains exist in the solutions of sufficient stability to resist disruption by the spreading action of the water. Plasticisers which are slightly soluble in water are dissolved out of the film whilst insoluble plasticisers have their molecular motions impeded by the cellulose chains. In the *Discussion*, **J. R. Katz** suggested that hexose groups rotate about their long axis so as to occupy less space upon the water surface, and thus compressibility of the film is obtained ; **H. Mark** pointed out that the results from compression curves indicate the flexibility of the long chain molecules which is necessary for the formation of bundles and micelles ; **E. G. Cox** mentioned that spreading and X-ray experiments are confirmatory, X-ray studies show that in crystalline carbohydrates the pyranose ring cannot have the Sachse " trans " form. Present evidence favours a ring of five carbon atoms coplanar, with the oxygen atom displaced out of it, β glucose, the reducing group is upon the same side of the ring as the oxygen atom, and models show that for a chain of β glucose units (*i.e.*, cellulose) a straight form can be assumed, but a chain of α glucose units (*i.e.*, starch) cannot be rectilinear ; and **W. B. Lee** referred the results to the range of molecular attraction, since the cellulose derivatives discussed spread upon water to a film one molecule thick, and the films so produced are stable. The discussion is applied to theories of dust and vacua, etc. S. G. B.

1270. Dried Collodion Membrane. L. Michaelis. *Kolloid Zeits.* 62. *pp.* 2–9 ; *Disc.*, 9–10, *Jan.*, 1933.—Measurements of the concentration potentials of dried collodion membranes separating solutions of lithium, sodium, potassium, and hydrogen chlorides of different concentrations at 20°C give results agreeing with the theoretical maximum effect the more nearly for small concentration-ranges. The chemical potential, using different chlorides on the two sides of the membrane, has also been investigated and the relative mobilities of the various kations calculated. For the series Li : Na : K : Rb : H, the relative mobilities into free aqueous solutions without membrane are in the proportions 0·52 : 0·65 : 1 : 1·04 : 4·9, whereas with the membrane the ratios become 0·048 : 0·14 : 1 : 2·8 : 42·5. Thus the order is the same in the two cases, but the degrees of variation differ greatly. The mobilities of the alkali metal kations are vanishingly small in comparison with that of the hydrogen ion, and a membrane for which the diffusion of K can be readily measured is virtually impermeable to Na. Experiments with glycerol : glucose, acetone-glucose, and acetone-glycerol show that, here too, the diffusibility diminishes rapidly with increasing molecular magnitude. Whereas, for free diffusion (neglecting colloids), differences in the diffusion coefficients in the ratio of 1 : 2 may be regarded as large, this ratio may easily reach 1 : 1000 in the membrane. The interpretation of these results in the light of the above theory is considered. T. H. P.

1271. Fine Structure and Mechanical Properties of Fibres. H. Mark. *Faraday Soc., Trans.* 29. *pp.* 6–10 ; *Disc.*, 10–13, *Jan.*, 1933.—A survey of the nature and structure of cellulose fibres with particular reference to their micellar structure and the influence of extension thereon. A mathematical treatment is developed for the extension of a micellar system which gives the connection between the strength of the fibre, the extension and the axis ratio of the micelles. It is shown that only a carefully treated cellulose material which contains long bundles gives good and fast fibres. In the *Discussion*, **van Iterson** stated that in stretching non-ductile fibres the form of the curve followed the mathematical expression due to Mark, but with high values of the numerical coefficient, showed that in the case of ductile fibres still more concave forms of the curve are obtained, and attributed the differences in the two curves to micellar orientation ; **H. J. Woods** suggested that in regard to the mathematical treatment of extension greater than 100 % the formula proposed is scarcely adequate if the neglect of certain terms is allowed, and proposed a modification of the integral which meets the case ; **P. P. v. Weimarn** put forward a method for demonstrating the influence of the degree of orientation of the disperse particles upon the tensile strength of the thread. S. G. B.

1272. Relations between the Refractive Indices and the Behaviour of Cellulose Fibres. J. M. Preston. *Faraday Soc., Trans.* 29. *pp.* 65–71 ; *Disc.*, 71–77, *Jan.*, 1933.—The Nageli discovery of birefringence of cellular structures has been usually investigated qualitatively rather than quantitatively, the earliest work being probably due to Frey. The present paper shows that the indices of native mercerised and regenerated cellulose fibres are quantitatively related to the orientation of the cellulose micelles of which the fibres are built. If mercerisation takes place with fibres under tension or otherwise, then the degree of such tension determines the degree of mercerisation. The quantitative effect of tension upon the change of refractive indices on mercerisation, the contraction of the fibres mercerised without tension, is deduced. The refractive indices of regenerated cellulose rayons serve as an indication of their degree of extensibility. In the *Discussion*, **W. T. Astbury** stated that the extension of wet rayon is not entirely due to micellar rotation, suggested that X-ray data should be carefully compared, and that the extension of a perfectly isotropic fibre should be 57·08 %, and not 42·3 % as given in the paper; **G. van Iterson** applying the Decke method for refractive index, confirmed the author's results, and in regard to the refractive index of valonia utricularis followed the findings of Astbury and Frey; **R. D. Preston** pointed out that the anomalous value of n_a mentioned is a real effect, probably due in cotton to the hair structure, gave an explanation; **E. G. Cox** mentioned that a factor which is as important as micellar orientation is the relative orientation of neighbouring valency chains inside the micelle. S. G. B.

1273. Lattice Changes of Nitrocellulose. J. J. Trillat. *Faraday Soc., Trans.* 29. *pp.* 85–89, *Jan.*, 1933.—Trogus, Hess and Katz have suggested that the fibres of nitrated ramie, at the maximum, swelled in certain mixtures of organic liquids, *e.g.*, methanolcyclohexanone, and examined by X-rays, show a change in the position of the crystalline interferences: a reversible phenomenon which gradually disappears as the liquid evaporates from the fibre until the unaltered original diagram is once more extant. They suggest that there is for certain swelling media a combination between the cellulose and the medium, forming a compound analogous to a dissociable hydrate. The present paper records experiments on similar lines whereby a compound is definitely formed in the case of nitrocellulose and camphor, and probably in the case of many plasticisers and solvents. The paper is a record of the results of X-ray analysis of such compounds and reactions. The results are interpreted as stated above. S. G. B.

1274. Electrical Resistance of Wool Fibres. M. C. Marsh and Kathleen Earp. *Faraday Soc., Trans.* 29. *pp.* 173–192; *Disc.*, 192–193, *Jan.*, 1933.—A modification of the method of measurement of high resistances due to Townsend is used. The fibres are insulated and mounted in a thermostatic arrangement so as to give control of the conditions of humidity and temperature during the experiment. The hystersis curves for resistance and humidity are given, and in explanation it is suggested that longitudinal conduction in the fibre takes place through water paths of varying cross-section. The large increase of resistance for small decreases of water content are accounted for by the assumption that the water channels break down, those of greatest cross-section disappearing first at their widest points. The high value obtained for the specific resistance would indicate the possible commercial uses of wool as an insulator. In the *Discussion*, **J. B. O'Sullivan** stated that, assuming the validity of the Kelvin equation, the effective capillary radius of the pores can be calculated from the data for water vapour pressure of cotton at various moisture contents; since most ions are hydrated and therefore carry an atmosphere of water with them, they would experience a resistance proportional to the viscosity of the liquid through which they migrate; in capillary tubes the viscous hindrance is proportional to the fourth power of the radius, and if this rule holds down to the value of the radii calculated from the Kelvin equation, the electrical resistance would change 10^8-fold; this is sufficient to account for the change in resistance with the moisture content; **E. G. Cox** mentioned that the hysteresis effect observed is paralleled in the determination of the adsorption isotherm of cellulose fibres under varying humidity; **J. R. Katz** pointed out that the measurement of the electrical resistance as a function of the degree of swelling presents a new method for the closer study of the orientation of water molecules on the surface of the micellæ, the existence of which is indicated in the diminution of entropy in swelling. S. G. B.

1275. X-Ray Analysis of the Structure of Animal Hairs and Other Protein Fibres. W. T. Astbury. *Faraday Soc., Trans.* 29. *pp.* 193–205; *Disc.*, 206–211, *Jan.*, 1933.—A description of the X-ray analysis of the structure and constitution of hair and wool, as also feathers. The existence of a protein chain of the type usually associated with proteins is found, except that in the case of wool the chain takes a configuration of pseudo hexagons. The linkages and the possible methods of combination within the micelle are discussed, and the fact is elucidated that unstretched hair is not in a state of maximum contraction. Hair does not show any internal slipping when stretched, and there is no evidence of discontinuity of molecular or crystalline structure. The results are compared and confirmed by swelling and other data. A full and detailed argument is set out. In the *Discussion,* **D. J. Lloyd** stated that the molecules of the protamines are heavily loaded with polar groups, mostly of basic character, and electric repulsions between these might be expected to keep the backbone of the molecule extended; protamines are undoubtedly involved in the chemistry of cell activity, and are intimately connected with nuclear division and cell growth; it would appear that the form of the molecule in this case may possibly lead to the highest potentialities for chemical activity; **H. Mark** emphasised the important role played by cross linkages in the chemical behaviour of proteins and drew the analogy with slightly vulcanised rubber and the natural variety; **R. A. Peters** mentioned that organised protein structure is an essential responsible for co-ordinate activity; **J. R. Katz** pointed out that in the unstretched state rubber shows, in X-ray analysis, an amorphous ring, whilst when stretched it has a fibre diagram, thus the stretching renders the amorphous part crystalline; a comparison of the X-ray pattern of amorphous rubber with that of different liquids seems to show that the period of identity of the amorphous ring of rubber and of liquid hydrocarbons measures the transverse distance of hydrocarbon chains lying parallel in small groups, thus a group structure for liquids may be assumed; and suggested that heat of swelling of stretched and unstretched wool fibres should be determined in a strong swelling agent which causes permanent stretching to go back, and thus the heat of stretching wool fibres may be determined. S. G. B.

1276. Physical Significance of Crimp or Waviness in Wool Fibre. S. G. Barker. *Faraday Soc., Trans.* 29. *pp.* 239–250; *Disc.*, 251–257, *Jan.*, 1933.—An analogy to Euler's equation is postulated for the relationship between the various dimensional characters of the fibre, which is vindicated by actual measurement. A mathematical theory is given showing that all forms of crimp fall within the range of the combination of action of two simple harmonic forces at the follicle. Thus phase difference as it varies accounts for the variation in the crimp configuration. The nature of such forces is discussed, and it is suggested

V. 19

that the phenomenon might result from periodic physico-chemical reaction in the follicle. Evidence in support is quoted. In the *Discussion*, **E. Hill** suggested that dehydration may be the determining factor. The author shows that crimp is a periodic function of time only, independent of the length of the fibre or of the thickness, etc. In conclusion, attention is drawn to the curved nature of the cortical cells and also that the dehydration theory is in no way opposed to the periodic physico-chemical explanation. S. G. B.

1277. Tensile Properties of Silk Filaments. W. S. Denham and T. Lonsdale. *Faraday Soc., Trans.* 29. *pp.* 305–316, *Jan.*, 1933.—The results of experimental work are recorded in a series of tables and details of the methods employed are given. Values are shown for the tensile properties of mulberry silk obtained by a recording extensometer, direct loading of filaments by weights, and by stretching the filaments to a definite amount by a pull. The extensometer load-extension curves are similar in form in all cases, although varying individually. The average values per filament at the proportional limit, and at break are registered, as well as derived quantities such as Young's modulus and tensile strength. The moisture content of silk from different origins is given, as also the connection between tensile strength and humidity. S. G. B.

1278. Sedimentation Equilibrium in the Ultra-Centrifuge: Types Obtained with Soap Solutions. J. W. McBain and M. E. L. McBain. *Roy. Soc., Proc.* 139. *pp.* 26–37, *Jan.*, 1933.—A discussion of sedimentation equilibrium as opposed to sedimentation velocity. It is shown that, in systems where dissociation occurs, both ions, crystalloid and colloid, must be taken into account; and that, if only the effect of the colloid ion is considered, true molecular weights are obtained only at the iso-electric point. Soap solutions have been examined by Svedberg's ultra-centrifuge, in which the field is about 100,000 times gravity. The sedimentation equilibrium is dynamic in the sense that the rapid sedimentation of the neutral micelle leads to formation of more micelles in the diluted part of the solution while the concentration of micelles by sedimentation leads to a breakdown of some of these to simpler units in the more concentrated part. Soap solutions show three types of sedimentation: upwards, downwards or both together. The direction depends on the partial specific volume of the micelles and on the density of the solution. In $0 \cdot 25N$ sodium oleate sedimentation is upwards; in $0 \cdot 5N$ potassium laurate it is downwards. In $0 \cdot 5$ potassium laurate $+ 1N$ potassium chloride and in $0 \cdot 5$ lauryl sulphonic acid it is both upwards and downwards. This sedimentation separation is attributed to rise of the neutral micelles and fall of the ionic micelles. A. S. C. L.

1279. New Investigations for the Measurement of the Migration-Velocity of Colloid Particles. W. Hacker. *Kolloid Zeits.* 62. *pp.* 37–41; *Disc.*, 41–42, *Jan.*, 1933.—In this paper an apparatus is described whereby disturbances due to the contact of the colloidal sol with crystalloidal solutions are avoided, and results are included for an iron oxide sol in contact with hydrochloric acid solutions of different concentrations. The discussion deals mainly with the defects of former methods. H. H. Ho.

1280. Determination of Jelly-Strength and Modulus of Elasticity E_D of Glue Jellies and Influence of Additions on Viscosity and E_D. E. Goebel. *Kolloid Zeits.* 62. *pp.* 54–60, *Jan.*, 1933.—Descriptions are given of apparatus for determining jelly strength and E_D and of a new elastometer, designed for technical purposes and allowing the relative jelly strength and E_D to be calculated. From the results obtained by means of a plain punch, E_D may be determined from Hooke's formula, $E_D = PL/lq$, where P is the load in gm., L is the punch diameter multiplied by a factor in mm., l is the penetration of the punch in mm., and q is the cross-section of the punch in sq. mm. E_D diminishes rapidly as the temperature is raised, especially with gels of low concentration. The relation between viscosity and E_D for skin, bone and chrome glues is indicated. Within the pH-range 5·0–7·5 E_D is practically independent of the hydrogen-ion concentration. Addition of formaldehyde or alum effects marked increase in the viscosity of skin glues, but only an unimportant alteration in the values of E_D. Zinc sulphate produces no change in either viscosity or E_D of glue solutions. T. H. P.

1281. Method for the Separation of Different Disperse Systems by Cataphoresis. H. Bennhold. *Kolloid Zeits.* 62. *pp.* 129–131, *Feb.*, 1933.—An apparatus is described, together with experimental details, for the separation of the components of a mixture by taking advantage of the different velocities of the particles in the same electrical field. Various applications to biological disperse systems are discussed. H. H. Ho.

1282. Periodic Precipitation of Mercuric Iodide. Suzanne Veil. *Comptes Rendus*, 196. *pp.* 266–268, *Jan.* 23, 1933.—The appearances observed when drops of solutions of KI and $HgCl_2$ are placed near each other on a film of gelatin, and when a drop of the former is placed on gelatin impregnated with $HgCl_2$ are described. In the latter case the ring, at first yellow and then red, consists of microscopic rings, increasing in width with distance from the centre, with a clear space between the drop and the first ring. C. A. S.

See also Abstracts 1245, 1358, 1359, 1607.

CRYSTAL STRUCTURE AND PROPERTIES.

1283. Laue Patterns from Thick Crystals at Rest and Oscillating Piezoelectrically. J. M. Cork. *Phys. Rev.* 42. *pp.* 749–752, *Dec.* 15, 1932.—Laue photographs are taken of thick crystals of quartz and Rochelle salt oscillating piezoelectrically and at rest. Natural cleavage surfaces, polished surfaces and etched surfaces are used. The Laue spots are doubled in all cases, but the nature of the doubling depends on the conditions. It is concluded that further elaboration of the Laue diffraction theory is necessary to account for the results obtained. J. T.

1284. Crystal Symmetry and Lattice Vibrations. A. D. Fokker. *Physica*, 13*e*. 1. *pp.* 1–30, 1933. *In German.*—A full discussion of the possible vibrations in various symmetrical atomic arrangements. Symmetric operations are generated by means of elementary sectors, in which the motions must all be the same, either simultaneous or with definite phasal relationships. The consequences of "degenerate" oscillations for secondary axes of symmetry are brought out. F. I. G. R.

1285. Sodium-Lead Alloys. Structure of the Compound Known as Na_4Pb. C. W. Stillwell and W. K. Robinson. *Am. Chem. Soc., J.* 55. *pp.* 127–129, *Jan.*, 1933.—Analysis of X-ray diffraction data for the compound known as Na_4Pb indicates that its structure is face-centred cubic, with $a_0 = 13 \cdot 27 \pm 0 \cdot 035$Å. There are 78 atoms to the unit cell. It is apparently analogous to the familiar γ-phase of copper, silver and gold alloys and its more exact formula is therefore $Na_{31}Pb_8$. F. J. W.

1286. Typical Spinels. C. W. Parmelee, A. E. Badger, and G. A. Ballam. *Univ. Illinois, Eng. Exp. Sta., Bull. No.* 248. [56 *pp.*], *June* 17, 1932.—A comprehensive report, dealing with such properties of spinels as are of prime importance for industrial purposes. The following sections are given, accompanied, where necessary, with full tabular matter: Synthesis and properties; scratch hardness of synthetic spinels; densities; X-ray analyses; heat capacities; thermal expansions; and an Appendix containing computational data. F. I. G. R.

1287. Crystal Structure and Morphology of Gallium. F. Laves. *Zeits. f. Krist.* 84. *pp.* 256–298, *Jan.*, 1933.—The crystal system is rhombic pseudo-tetragonal with $c/a = 1 \cdot 697$. Strictly, a species of molecular lattice exists, with units of Ga_2. Probable space group, V_h^{18}. More broadly, each Ga has one neighbour at a distance of 2·45 A°, and two each at distances 2·70, 2·73, 2·79Å°. A morphological discussion concludes the paper. F. I. G. R.

1288. Crystal Structure of Sulvanite. L. Pauling and R. Hultgren. *Zeits. f. Krist.* 84. *pp.* 204–212, *Jan.*, 1933. *In English.*—Sulvanite, Cu_3VS_4, is cubic, a 5·370Å, with one mol. in the unit cell, space group T_d^2 ($P\bar{4}3m$). Each copper and each vanadium atom is surrounded tetrahedrally by four S atoms, Cu–S=2·285, V–S=2·186Å; each sulphur atom by three Cu atoms at three of the corners of a tetrahedron with one vanadium atom in the pocket formed by the copper atoms, the atomic arrangement being V at 000, 3Cu at ½00, 0½0, 00½, and 4S at uuu, $u\bar{u}\bar{u}$, $\bar{u}u\bar{u}$, $\bar{u}\bar{u}u$, a new structure. Cu probably resonates between Cu′ and Cu″, and V between V^v and lower states. C. A. S.

1289. Crystal Structure of Rubidium Nitrate. L. Pauling and J. Sherman. *Zeits. f. Krist.* 84. *pp.* 213–216, *Jan.*, 1933. *In English.*—Rubidium nitrate, though really rhombic, very closely approximates to hexagonal. Regarded as hexagonal it has a 10·45, c 7·38Å, with 9 molecules in the unit cell, space group C_{3v}^8 ($H3m$); regarded as rhombic the unit cell has a 18·08, b 10·45, c 7·38Å and contains 18 molecules. C. A. S.

1290. X-Ray Investigation of 12-Molybdophosphates and Related Compounds. J. L. Hoard. *Zeits. f. Krist.* 84. *pp.* 217–230, *Jan.*, 1933. *In English.*—The following have been examined, all are cubic, space group probably O_h^7, with 8 mols. in unit cell (the figures after each give the value of a in Å, and the density): $XPMo_{12}O_{40}, 30H_2O$ ($X = H_3$ 23·1, 2·52; Nd 23·1, 2·62; Sm 23·1, 2·60; Gd 23·1, ?); $Y_2SiMo_{12}O_{40}, 31H_2O$ ($Y = Mg$ 23·04, 2·56; Ni 23·0, ?); and $Be_2SiW_{12}O_{40}, 31H_2O$, 23·3, 3·66. A structure is suggested. C. A. S.

1291. Crystal Structure of Potassium Silver Cyanide. J. L. Hoard. *Zeits. f. Krist*, 84. *pp.* 231–255, *Jan.*, 1933. *In English.*—A hexagonal unit cell is found, with $a = 7 \cdot 384 \pm 0 \cdot 010$Å, $c = 17 \cdot 55 \pm 0 \cdot 02$Å. The space-group is either D_{3d}^2 or C_{3v}^4, probably the former. The structural units are K^+ ions, with linear, or nearly linear, $[Ag(CN)_2]$ ions, making an angle of about 27° with c. A value of 2·56Å is obtained for the K-N separation $(K\text{-}N)_3$. An electron pair between each potassium and one nitrogen atom is suggested to account for this abnormally small figure. F. I. G. R.

1292. Crystal Structure of Borides of the Composition XB_6. M. v. Stackelberg and F. Neumann. *Zeits. f. phys. Chem.* 19. *Abt. B.* 5. *pp.* 314–320, *Dec.*, 1932.—CaB_6 exhibits a cubic CsCl-structure of calcium atoms and B_6-groups, the six boron atoms occupying the angles of an octahedron. Similar structure must be ascribed to the analogous borides of Sr, Ba, La, Ce, Pr, Nd, Er and Th. These compounds have a metallic character. T. H. P.

1293. Binding Energies in the Growth of Crystal Nuclei from Metallic Atoms. H. S. Taylor, H. Eyring and A. Sherman. *J. Chem. Phys.* 1. *pp.* 68–76, *Jan.*, 1933.—First order perturbation theory is used to compute the binding energies of various geometrical configurations of three to eight sodium atoms, it being assumed that, in the metal lattice, the binding is essentially homopolar. It is shown that the growth of a unit cell probably proceeds via the diatomic molecule to a square, a fifth atom being added along a cube edge, a sixth at the body centre, and the cell completed by location of atoms at the remaining corners of the cube. The unit cell is still very unstable, a result in agreement with high vapour pressures and solubility of finely divided particles, and with the concept of active centres on reaction surfaces. The fifth-order secular equation employed to determine the energies of configurations of five and six atoms has been modified to render calculations more simple, and a fourteenth-order equation with similar characteristics is used for the cases of seven and eight atoms. Approximate calculations for copper atoms instead of sodium give similar results, but indicate that higher activation energies of nuclei formation may obtain in this case. The percentage of the total binding assigned to interchange is shown to be an important factor. Indications are obtained that the net effect of interchange forces in homopolar crystals is to increase the potential energy, the crystal structure being stable only because of the coulombic and van der Waals' forces. With hydrogen, a metallic lattice appears to be utterly unstable. T. H. P.

1294. Crystal Structure of Sodium Ferrite. M. S. Goldsztaub. *Comptes Rendus*, 196. *pp.* 280–282, *Jan.* 23, 1933.—$Fe_2O_3 \cdot Na_2O$ is obtained in minute crystals (hexagonal or rhombohedral), optically negative. For $U = 2/9$, $Fe - O = 1{\cdot}95$Å. The co-ordinates are Na, (0, 0, 0), Fe $(\frac{1}{2}, \frac{1}{2}, \frac{1}{2})$, O $\begin{bmatrix} \frac{2}{9}, \frac{2}{9}, \frac{2}{9} \\ -\frac{2}{9}, -\frac{2}{9}, -\frac{2}{9}. \end{bmatrix}$. F. I. G. R.

1295. Orientation of Organic Crystals in Contact with Ionic Minerals. L. Royer. *Comptes Rendus*, 196. *pp.* 282–285, *Jan.* 23, 1933.—Effects are found for organic compounds which are ionised in solution. No result with molecular lattices. [See also Abstract 2719 (1932).] In a note, **G. Friedel** considers the evidence of mutual orientation as a criterion of binding. F. I. G. R.

1296. Liquid Crystal Character of Dipole Liquids at the Melting Point. L. S. Ornstein, W. Kast and P. J. Bouma. *K. Akad. Amsterdam, Proc.* 35. 10. *pp.* 1209–1212, 1932. *In German.*—Dielectric measurements of *p*-azoxyanisole and benzophenone are recorded which show that immediately prior to fusion and also to crystallisation, some of the molecules appear to be associated in groups of quickly changing dimensions. Measurements for other bodies which do not possess a liquid crystal phase, show that the above effect is favoured by the possession of permanent dipole moments. H. H. Ho.

1297. Rhythmic Precipitates. T. Isemura. *Chem. Soc. Japan, Bull.* 8. *pp.* 11–14, *Jan.*, 1933.—In silica gel containing substances which reduce particle size, precipitation of calcium oxalate, strontium oxalate, copper hydroxide and lead chromate occurs in the form of Liesegang rings. A. S. C. L.

1298. Rhythmic Crystallisation of Alkali Carbonates in the Presence of Gelatin. Suzanne Veil. *Comptes Rendus,* 196. *pp.* 109–110, *Jan.* 9, 1933.—Rhythmic crystallisation of the carbonates of lithium, sodium and potassium occurs in the presence of gelatin. A. S. C. L.

1299. Graphical Method of Interpreting Weissenberg Photographs. W. A. Wooster and Nora Wooster. *Zeits. f. Krist.* 84. *pp.* 327–331, *Jan.*, 1933. *In English.*—Charts and tables are given for interpreting equatorial and layer-line Weissenberg photographs for the case in which the X-ray beam is normal to the axis of rotation. From the charts the polar co-ordinates of the points in the reciprocal lattice are obtained. The method of constructing the charts is explained. J. T.

1300. Two Rulers for Use in Analysing Rotating Crystal Photographs. M. L. Huggins. *Rev. Sci. Instruments,* 4. *pp.* 10–13, *Jan.*, 1933.—The first ruler described is a pivoted ruler for use in the construction of a rotation diagram. The second ruler is for obtaining interplanar distances directly from an X-ray photograph. J. T.

1301. Preparation of Collodion Filters for X-Rays. H. Kersten and J. Maas. *Rev. Sci. Instruments,* 4. *p.* 14, *Jan.*, 1933.—Directions are given-for making a film of MnO, using collodion and alcohol, for use in cutting out the Kβ radiation of Fe. Suitable filter substances are given for making collodion filters for Cr, Cu and Mo radiation. J. T.

See also Abstracts 1247, 1274, 1310, 1315, 1430, 1436, 1472, 1475, 1476, 1532, 1598, 1599, 1641, 1662.

DENSITY.

1302. Improved Gas Density Balance with Electromagnetic Measuring Device. E. Lehrer and E. Kuss. *Zeits. f. phys. Chem.* 163. *Abt.*A. 2. *pp.* 73–81, *Jan.*, 1933.—The balance is similar to that of Stock and Ritter [see Abstract 1389 (1929)], but the sensitivity to external magnetic fields is reduced by the use of an astatic pair in place of the single magnet, and the wandering of the zero is avoided by providing knife edges riding on an optically polished agate plate. The sensitivity is 1 optical scale division (about 0·03 mm. at the balance pointer) for a change in density of 4×10^{-8} gm./cm.^{3} with the period 11 sec. The balance is no more delicate than a good analytical balance. Expressions are given for two corrections due to the change in the volume of the buoyancy sphere with pressure ; a small correction consequent on change in the volume of gas displaced, and a much larger one consequent on displacement in the centre of gravity of the sphere. It is deduced that for precise measurements the balance must be standardised with a gas whose density differs but little from that of the gas under test. P. H. B.

1303. Variations in the Density and the Oxygen Content of Atmospheric Air. A. Stock, H. Ramser and G. Eyber. *Zeits. f. phys. Chem.* 163. *Abt. A.* 2. *pp.* 82–90, *Jan.,* 1933.—The apparatus described by Lehrer and Kuss [see preceding Abstract] was used to redetermine the day to day variations in the density of atmospheric air under standard conditions. The determined standard density at 19·9°C varied between 1·20473 gm./litre and 1·20569 gm./litre, which is a somewhat smaller variation than was found in earlier work, but higher than that found by most other workers. Simultaneously with the density measurements the oxygen content of the air used was determined. The resulting determined variation in oxygen content is within 0·1%. The difference between the extreme values of other workers, excluding Jolly and Moles, is 0·16%. Jolly (in 1879) found a variation of 0·5%. Moles (in 1930) found a variation of 0·25% and his density determinations were in agreement with the results of his chemical analyses. A variation of 0·8% would be required to account for the authors' determined variation of 0·001 gm./litre. There was no connection between the determined standard density and the pressure. It is concluded that an explanation must be sought in the study of the atmospheric gases from which the oxygen has been absorbed. P. H. B.

1304. Normal Density of Ammonia. G. Dietrichson, L. J. Bircher, and J. J. O'Brien. *Am. Chem. Soc., J.* 55. *pp.* 1–13, *Jan.,* 1933.—A precision method is described for the determination of gas densities, making possible the definite elimination of adsorption effects, and suitable for use over a wide temperature range. Data obtained lead to the value 0·77126 ± 0·00001 for the normal density of ammonia. N. M. B.

1305. Density of Ammonia at Reduced Pressures and its Relation to the Atomic Weight of Nitrogen, the Gas Constant R, and the Limiting Molal Volume V_0. G. Dietrichson, C. W. Orleman, and C. Rubin. *Am. Chem. Soc., J.* 55. *pp.* 14–21, *Jan.,* 1933.—A precision method [see preceding Abstract] is applied to the determination of the density of ammonia at ⅔ and ⅓ atmosphere, and gives the values (±0·00001) 0·51161 and 0·25458, respectively. The gas density method of determining atomic weights is discussed. The gas constant and limiting molal volume are computed by means of linear and quadratic equations of state developed on the basis of density data for ammonia. N. M. B.

1306. Density of Soda-Lime-Silica Glasses as a Function of the Composition. F. W. Glaze, J. C. Young and A. N. Finn. *Bureau of Standards, J. of Research,* 9. *pp.* 799–805, *Dec.,* 1932.—The investigation of the relations between chemical composition and certain physical properties of glasses has been continued. A former paper dealt with the index of refraction of certain soda-silica and soda-lime-silica glasses [see Abstract 3770 (1931)], and the same glasses, together with additional samples, were used for the density determinations. In a manner analogous to that employed in the refractive index work, the results of the investigation of density may be used, within the range of compositions considered, to predict accurately (1) the density of any glass from the composition and (2) the compositions of the various glasses having equal densities. Also, some evidence is presented indicating that the density of the soda-silica glasses is a simple function of certain soda-silica compounds which may be present in the glass. H. B.

1307. Andreae's Methods for the Determination of the Density of Solids. E. Cohen and W. A. T. Cohen-de Meester. *K. Akad. Amsterdam, Proc.* 35.10. *pp.* 1255–1266, 1932. *In German.*—Attention is drawn to two methods devised by J. L. Andreae for the determination of the density of soluble solids with an accuracy of a few parts in 10,000. *First Method.*—Air free crystals are formed in a pyknometer consisting of a bulb (volume 10 to 20 ml.) surmounted by a graduated tube (length 10 cm., internal diameter 3 mm.) in turn surmounted by a wide tube (diameter 25 mm.). The mass and the volume of the crystals are determined by a described procedure and thence the density is calculated. Results obtained by Andreae and others for various substances are given. A modification in procedure made by the authors in order to speed up the density determinations without loss of accuracy is described. *Second Method.*—Specially prepared crystals not larger than 1 mm. are placed in a dilatometer containing a mixture of two liquids in which the crystals are insoluble, one liquid being heavier and one lighter than the crystals. The temperature is adjusted until the crystals tend neither to sink nor to rise, and the density of the liquid, which is the same as that of the crystals, is then determined. Precautions for accurate results are enumerated, and a method of obtaining small homogeneous crystals is described. Andreae's results by the two methods are in agreement within two parts in 10,000. P. H. B.

See also Abstracts 1290, 1336, 1529, 1541.

DIFFUSION AND OSMOSIS.

1308. Permeability of Quartz and Pyrex and Other Glass to Helium. J. C. McLennan and J. O. Wilhelm. *Roy. Soc. Canada, Trans.* 26. *pp.* 119–122, May, 1932.—In some experiments with helium it was found that vacuum flasks constructed from pyrex glass became inefficient. To examine the matter further three discharge tubes were made, one of pyrex, one of quartz, and the third of soft glass. Leakage of helium was observed in the case of the quartz and the pyrex, and it was concluded that pyrex vacuum flasks are unsuitable for use in a helium atmosphere. T. B.

See also Abstracts 1270, 1282, 1327, 1350, 1358, 1359.

ELASTICITY AND PLASTICITY.

1309. Variable Rotation of an Elastic Solid. L. Lecornu. *Comptes Rendus,* 196. *pp.* 73–77, *Jan.* 9, 1933.—Through a solid of revolution is fixed a cylindrical rod by which couples are applied to give the system a variable angular velocity. The equations for the resulting elastic displacements are given. In the case of an ellipsoid of revolution, which is discussed in detail, at the surface of the rod three regions may be distinguished, the innermost of which experiences a tension in the opposite direction to those on the remaining pair. The signs of these tensions are reversed when the quantity $3a^2—2b^2$ changes sign, where a and b are the major and minor axes of a meridian. Application of the results to fatigue in rotating mechanism is discussed. J. P. A.

1310. Elasticity of Wet Salt Crystals. K. H. Dommerich. *Zeits. f. Physik*, 80. 3–4. *pp*. 242–251, *Jan*. 23, 1933.—An experimental arrangement is described by which thin crystal rods can be obtained which are uniform in cross-section throughout their length. This is achieved by rotating the specimen at a uniform rate in water so that it dissolves uniformly. The elastic properties of the specimen are investigated under the above conditions and are compared with those of dry and of non-uniform wet crystals. Wet uniform rods have a higher normal breaking stress than have non-uniform rods. Previously deformed rods have higher breaking stresses than undeformed. The elastic limit of previously undeformed and uniformly dissolved cleavage rods of rock-salt agrees within the error limits with that of dry natural crystals. In the case of undistorted uniform rock-salt rods the limiting compression to produce dodecahedral slip is accurately constant, the elastic limit in tension naturally depending upon the orientation of the zone axis. J. E. R. C.

1311. Principle of Reciprocity Applied to Mechanical Vibrations. A. Steinheil. *Zeits. f. techn. Physik*, 14.1. *pp* 36–39, 1932.—An elastic structure is subjected at a point A to specified impulsive or periodic force, and the alteration in the motion at a second point B is observed. If now the points of application and observation are interchanged, the change in motion at A bears a simple relation to that formerly observed at B. This principle, which is applicable to systems subjected to damping proportional to the deformation velocity, is tested experimentally with damped, coupled pendulums, and with a large cast-iron floor upon which metal balls are dropped. The results verify the reciprocal relation deduced in the paper. An application to forced oscillations is also described. J. P. A.

1312. Analysis of Compound Wave-Forms. J. S. Thompson. *Phil. Mag.* 15. *pp*. 1–15, *Jan*., 1933.—A method is described of obtaining with an oscillograph the traces of pure sine waves, singly and when compounded in pairs. The compound waves are divided into three classes, (1) having distinct beats, (2) having less marked but quite definite beats, (3) having no beats. A theoretical treatment of the composition of the waves is given, and the results applied to practical analysis of records in order to find the frequencies and amplitudes of the components. The frequencies can be obtained with a high degree of accuracy, but the error is often rather great in the smaller amplitude of the two waves. H. M. B.

1313. Solution of an Equation of Wave Motion. S. Soboleff. *Comptes Rendus*, 196. *pp*. 49–51, *Jan*. 3, 1933.—A representation of the solution of $\dfrac{\partial^2 u}{\partial^2\rho^2}+\dfrac{1}{\rho}\cdot\dfrac{\partial u}{\partial\rho}+\dfrac{1}{\rho^2}\cdot\dfrac{\partial^2 u}{\partial\phi^2}=\dfrac{1}{a^2}\cdot\dfrac{\partial^2 u}{\partial t^2}$ on the Riemannian surface of logarithmic type, is given. G. C. McV.

1314. Number of Pieces Resulting when Fragile Balls are Broken on a Hard Plate S. Suzuki. *Phys. Math. Soc., Japan, Proc.* 14. *pp*. 612–621, *Dec*., 1932. *In English*.—Balls differing in material and dimensions are let fall to an iron plate from various heights and are broken into pieces. If the balls are nearly uniform, both in size and material, they usually break into several large, equal, symmetrical segments together with many smaller fragments. It was found that there are two rules in connection with the number of broken pieces and the energy (expressed in height) of a falling ball. (1) The small pieces nearly always distribute themselves according to a rule $n\ (r - 0{\cdot}03)^2 = \beta h^{0\cdot 76}$, when n is the number of the broken pieces of a ball, r the ratio of the radius of one of the broken pieces to that of the ball, h the height at which the ball has been placed, β a constant. (2) The number of the large, equal, symmetrical pieces increases with the height in such a way that it remains the same for a definite interval of height until the ball to be dropped is raised higher when the number increases by one. The frequency-distribution of the broken pieces of balls thus obtained is compared with that of planetoids for the purpose of finding a clue to the mystery of their appearance in the universe. AUTHOR.

1315. Low-Temperature Tensile Strength of Rock-Salt. W. Burgsmüller. *Zeits. f. Physik,* 80. 5–6. *pp.* 299–301, *Jan.* 31, 1933.—The tensile strength of rock-salt is examined at different temperatures as that of a substance which, in contradistinction to plastic metals, shows an increase of strength as the temperature rises. As a matter of fact, the tensile strength has a minimum at −40°C. and then increases again somewhat. But up to about 400°C. the increase is rapid and regular. In liquid air the fission takes place sometimes according to a rhombic dodecahedron instead of a cube. E. E. F. d'A.

See also Abstracts 1271, 1277, 1280, 1331, 1336, 1386, 1436.

GRAVITATION.

1316. Sensitive Elastic Pendulum: Contribution to Gravity Survey of France. F. Holweck. *Comptes Rendus,* 196. *pp.* 44–46, *Jan.* 3, 1933.—A still further improved model of the elastic pendulum [see Abstract 1471 (1932)] has been made, 180 times as sensitive as the ordinary pendulum. Including mounting and dismounting a complete gravity determination therewith takes but 2–3 hrs. The constants of such a pendulum are given and the results of 32 gravity determinations during July–Sept., 1932, at 22 places in northern France, with the Bouguer corrections, and anomalies. C. A. S.

1317. Gravity Survey of Northern France. P. Lejay. *Comptes Rendus,* 196. *pp.* 46–49, *Jan.* 3, 1933.—The results of 44 similar gravity determinations at 41 places in northern France carried out during Oct.–Dec., 1932, are recorded, and iso-anomaly lines plotted on a map. The accuracy attained is to $<$ 1 milligal. [See preceding Abstract.] C. A. S.

1318. Temporal Variation in Gravity. R. Tomaschek and W. Schaffernicht. *Ann. d. Physik,* 15. 7. *pp.* 787–824, *Dec.,* 1932.—Experiments on the variation of the force of the earth's gravitational field are described. A specially sensitive bifilar gravimeter was employed, by means of which changes in the force of the order of $10^{-7}g$ can be determined. The objectives were to check the Courvoisier assumption that the earth's motion in space effects changes in g of the order of 6×10^{-6}, to permit more accurate determinations of time by means of the pendulum, and to observe the effect of the influence of the attraction of the sun and moon on the earth, as regards the magnitude of g. The observations have also important value in connection with the question of the yielding of the earth's crust under the varying force of gravity, and yield information as to the elastic constants of the earth. The gravimeter consists essentially

of the Schweydar bifilar type, in which a mass is supported partly by means of a long spiral spring and partly by means of two inclined suspension wires. With the aid of a torsion head, the circular mass can be twisted until it reaches a nearly unstable position, when it is extremely sensitive to further twisting. The spiral spring was made of elinvar, and the two wire suspensions of phosphor bronze ribbon, 0·008 × 0·17 mm. in cross-section and 43 cm. long. The spiral wire was of 0·5 mm. diameter, and had 130 windings ; it was 1·10 m. long under the load of its own weight of 12 gm. and that of the mass, 52·5 gm. The suspension system was enclosed in a carefully sealed casing, and extreme precautions were taken during observation to reduce temperature variations in the chamber to a matter of only 0·001°C. Observations were made automatically and photographically. As a result of the tests, the conclusion was drawn that the Courvoisier cosmic motion effect does not manifest itself. The influence of the sun and moon are, however, very apparent on the records, although these effects are only of the order of $6 \times 10^{-8}g$. Harmonic analysis of the records gives very good results. The most significant result of the observations is that the amplitudes observed are smaller than those anticipated on the hypothesis of a perfectly rigid earth. Also there is a phase retardation of about three-quarters of an hour, indicating an influence of the tides of the sea on the deformation of the solid earth.
E. L. J.

See also Abstract 1385.

HYDRODYNAMICS AND AERODYNAMICS.

1319. Solution of the Potential Flow for an Ideal Fluid in Two Dimensions. A. Miyadzu. *Tohoku Univ., Technol. Reports,* 10. 4. *pp.* 51–89, 1932. *In English.*—The potential flow of an ideal fluid in two dimensions is discussed by the method of conformal representation, and the results are applied to the discussion of flow in straight or curved channels with local divergence.
J. S. G. T.

1320. Demonstration Apparatus for Showing Stream-Lines. C. Wieselsberger. *Phys. Zeits.* 34. *pp.* 46–47, *Jan.* 1, 1933.—A modification of Hele Shaw's apparatus for demonstrating the lines of flow past an object immersed in a stream of fluid. Instead of the object, any desired arrangement of holes is provided so as to form a system of "sources" and " sinks " by means of which extra fluid can be introduced or removed from the continuous stream. In this way it is possible to demonstrate the form of stream line to be adopted for any given type of object.
J. W. T. W.

KINETIC THEORY OF MATTER.

1321. Effective Cross-Sections of Molecules According to the Kinetic Gas Theory. H. E. Binkele. Part II. *Ann. d. Physik,* 15. 6. *pp.* 729–734, *Dec.,* 1932.—No good agreement has been found hitherto between the values obtained for molecular quantities derived from viscosity considerations and from data given by band-spectra, or in other ways. In an earlier paper [see Abstract 3573 (1931)] the author showed that this was due to the inaccuracy of the Sutherland temperature function and that these discrepancies could be removed by referring the quantities to the same temperatures. It seems expedient, now that the $\eta - \tau$ function has become known through recent work [see Abstract 518

(1932)], to use the critical temperature as the point of reference. In this way very good agreement is found to hold between the numerical values obtained from the critical quantities and gas viscosity. H. L. B.

1322. Resistance of Small Spheres in Motion through Air. G. Mönch. *Phys. Zeits.* 34. *pp.* 77–79, *Jan.* 15, 1933.—By observation of the liquid droplets forming cigarette smoke, the modified Stokes formula given by Knudsen and Weber is found to be correct provided that the constants involved in the formula have the values found by Mattauch [see Abstract 2009 (1925)]. G. G. S.

1323. Theory of Inelastic Collisions between Atoms. E. C. G. Stueckelberg. *Helv. Phys. Acta,* 5. 6. *pp.* 369–423, 1932.—A lengthy and purely mathematical paper, in which the Wenzel, Kramers and Brillouin procedure [see Abstracts 2534 (1926) and 45, 904 (1927)] is applied to second order collisions between atoms. Two cases are recognised, according to whether or not the potential energy curves intersect. The calculation of the effective cross-section shows that the results accord better with experiment, both as regards the order of magnitude and the appearance of resonance, in the case in which the curves do not intersect, whereas the rapid ionisation produced by fast alkali ions is explained by intersection of the curves. The methods employed may be applied to pre-dissociation and to collisions between α-particles and atomic nuclei. H. F. G.

1324. Interchange of Vibrational and Translational Energy. C. Zener. *Cambridge Phil. Soc., Proc.* 29. *pp.* 136–141, *Jan.* 31, 1933.—The same perturbation method is found to be valid for a gentle mutual potential between free atom and vibrator as for an infinitely steep mutual potential, provided that the reduced mass of the system is sufficiently small. A simplified method is discussed for the calculation of transition probabilities. This method is used to calculate the effect of a van der Waals' attractive field. G. G. S.

1325. Reflection of Metallic Atoms from Alkali Halide Crystals. R. R. Hancox. *Phys. Rev.* 42. *pp.* 864–881, *Dec.* 15, 1932.—The scattering of molecular beams of mercury from crystals of LiF, LiCl, NaF, and KI has been studied as a function of crystal and beam temperatures. A similar study has been made of the scattering of a molecular beam of Cd from NaCl crystals. In all cases a quasi-specular beam of the type described by Zahl and Ellett [see Abstract 336 (1932)] for other alkali halide crystals was observed, with the same characteristic temperature changes. Former failures to detect a directed beam in the case of Hg scattered from KI were due to moisture on the crystal surface. The relative number of atoms in the directed beam is found to decrease with time at low crystal temperatures. J. J. S.

1326. Scattering of Molecular Rays in Gases. Part I. F. Knauer. *Zeits. f. Physik,* 80. 1–2. *pp.* 80–99, *Jan.* 6, 1933.—Molecular radiations from different gases were scattered both in the gases alone and in mercury vapour. The intensity distribution of the scattered radiation was studied for angles between 22·5° and 124° and it was found that the intensity of scattering was proportional to the pressure of the gas. Scattering curves can be explained on classical lines on the assumption of a force field between the molecules. Measurements at smaller scattering angles will be necessary in order to obtain diffraction phenomena. W. R. A.

1327. Kinetic Theory of Fluids. R. O. Herzog and H. C. Kudar. *Zeits. f. Physik,* 80. 3–4. *pp.* 217–231, *Jan.* 23, 1933.—Riecke's formula $D = \lambda v/3$, where λ is proportional to the mean free path, v is the molecular velocity and D the diffusion coefficient, is taken as a starting point. It is shown that λ is in fact $8/\pi$ times the mean free path. Another relation is that of Einstein, *viz.,* $D = kT/6\pi r\eta$, originally proposed for colloids. Here k is the Boltzmann constant, T the absolute temperature, r the molecular radius and η the viscosity. Other equations studied are those giving the dependence of viscosity on temperature. If $\eta = Be^{-Q/RT}$, then Q is found to equal the latent heat of the fusion of the substance.
J. H. A.

1328. Brownian Motion of the Resonance Radiometer. G. A. van Lear, Jr. *Rev. Sci. Instruments,* 4. *pp.* 21–27, *Jan.,* 1933.—The resonance radiometer consists of two under-damped galvanometers, each with a thermocouple in its circuit, and a pendulum of the same natural frequency as either galvanometer. This periodically interrupts the beam of radiation incident on the first thermocouple, and so sets the first galvanometer vibrating. The light beam from its mirror then falls on the second thermocouple. It is shown that the sensitivity limit for this arrangement from the point of view of Brownian movement is of the same order of magnitude as for the critically damped galvanometer, the advantage being in favour of the latter. However, with the resonance radiometer, other sources of disturbance may be made much smaller, so that practically this is the superior instrument. J. H. A.

See also Abstracts 1560, 1589, 1614, 1642.

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

See Abstract 1437.

MASS (STANDARDS, MEASUREMENTS, APPARATUS).

1329. New Sensitive Balance for Smallest Weights. W. W. Loebe and R. Kühn. *Zeits. f. Instrumentenk.* 53. *pp.* 21–27, *Jan.,* 1933.—The main features and difficulties in the use of other types of sensitive balances are first described. The new balance has a T-shaped beam of quartz with the ends of the short arm attached to the centres of two spiral springs. The other ends of the springs are joined to an arm rotating about a fixed axis. This fixed axis forms a continuation of the line joining the centres of the springs. A plane parallel strip of glass serves as pointer and has three lines etched on it. It moves across a scale. The long arm of the beam projects through a window and has a hook to support the load to be weighed. The outer part of the arm is in an enclosed space with glass sides. Tests show that even with rough treatment values are constant to 1–1·5%, temperature affects the results only to 0·01% per 1°C. for the range 4°–33°C., and fatigue after loading for 100 hours changes the values only by 0·1–0·7%. The cost of the instrument is extremely low, and it is useful for laboratory and works practice. R. S. R.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

1330. Amsler's Planimeter. J. Colomb. *Comptes Rendus,* 196. *pp.* 93–95, *Jan.* 9, 1933.—The general problem is to evaluate the rotation

of a wheel in terms of the track of the style along a non-closed arc. Resal gave a solution in 1873, but having obtained a term depending upon the root of a polynome of the 4th degree he concluded that it depended upon elliptical functions. The author sets out the full expression and shows that Resal's integral depends solely on a circular inverse arc sine function.
R. S. R.

1331. Applications of the Absolute Differential Calculus to Physics. C. Kaplan. *Phys. Rev.* 43. *pp.* 137–142, *Jan.* 15, 1933.—By means of the tensor analysis, coupled with the first fundamental theorem on the invariants of orthogonal transformations, expressions, independent of the particular type of co-ordinates used, are derived for Hooke's law in elasticity theory and for the constitutive relations in electromagnetic theory. It is shown that these two laws are but special cases of a more general physical law connecting, in a linear way, the components of two tensors having physical significance. It is to be noted that in the case of Hooke's law for a transversely isotropic medium, six independent co-efficients of elasticity are involved instead of five found in the corresponding classical expressions. AUTHOR.

1332. Determination of "Average Particle Size" from the Screen-Analysis of Non-Uniform Particulate Substances. T. Hatch. *Frank. Inst., J.* 215. *pp.* 27–38, *Jan.*, 1933.—The size distribution data obtained by screen analysis of a non-uniform substance cannot be used directly in calculating the various "average diameters" of the material, since this method of analysis gives the distribution in terms of weight. The distribution curve by weight, however, bears a definite relation to the normal size-frequency curve and suitable transformation equations are given by means of which it is possible to calculate the various "average diameters" from the parameters of the curve given by the screen analysis. In calibrating the screens preference is given to a definition in terms of the actual size of the material retained and not in terms of the dimensions of the screen openings. H. B.

1333. New Calculating Apparatus with Logarithmic Scales. R. Ravigneaux. *Comptes Rendus,* 196. *pp.* 96–97, *Jan.* 9, 1933.—The author describes the important features of an apparatus working by the method of coincidences such that when coincidence is obtained for two members on two scales their product is shown on a third scale. Three drums carry the logarithmic scales and have the same axis and radius, while they are connected by an epicycloidal mechanism. The accuracy can be increased by suitable gearing. The apparatus is a mechanical reproduction of M. d'Ocagne's nomogram. The theory of the method is outlined. R. S. R.

See also Abstracts 1339, 1577.

MECHANICS, CLASSICAL.

1334. Variational Principles and Dissipative Systems. J. L. Synge. *Roy. Soc. Canada, Trans.* 26. *pp.* 49–55, *May,* 1932.—Points out an ambiguity in the reasonings which have led Bauer and Bateman to apparently contradictory conclusions as to the relations between principles of variation and the equation of motion of dissipative systems. Discusses the conditions under which the equations of motion of a dissipative system are given by a variational principle, under which the trajectories of the system are the extremals of an integral. There exists no such principle for Whittaker's equations. A. D.

1335. Accelerations of the Points of a Rigid System in Plane Motion. G. Merlo. *N. Cimento*, 9. *pp.* 345–351, *Dec.*, 1933.—Some theorems concerning the acceleration centre of a rigid body moving parallel to a fixed plane are established. A. J. McC.

1336. Rapidly Oscillating Pendulums in Liquids. A. Krebs and H. Landsberg. *Zeits. f. Physik*, 79. 11–12. *pp.* 776–786, *Dec.* 30, 1932.—The influence of the nature of the surrounding liquid on the frequency and damping of pendulums oscillating at frequencies of the order of 60 has been studied, using such liquids as water, alcohol, chloroform, benzene, ether and pentane. In conformity with Kolaček's equation, N_0/N is a linear function of $\sqrt{S}$, where N_0 and N are the frequencies in air and in the liquid respectively, and S is the density of the liquid. The observed dampings caused by the densities and viscosities of the liquids are in close agreement with the values calculated from Klemenčič's equation. **Errata,** *ibid.*, 80. 7–8. *p.* 558, *Feb.* 6, 1933. H. F. G.

1337. Kinematic Supports and Clamps. L. R. Wilberforce. *Phys. Soc., Proc.* 45. *pp.* 120–125, Jan. 1, 1933.—An account, illustrated by the author's actual designs, of the theory and realisation of clamps and supports having one or more degrees of freedom. J. P. A.

See also Abstracts 1260, 1309, 1311, 1316, 1333, 1386, 1553.

MECHANICS, QUANTUM.

1338. Self-Consistent Fields and Free Electrons in Metals. Part III. L. Brillouin. *J. de Physique et le Radium*, 4. *pp.* 1–9, *Jan.*, 1933.—In continuation of previous work [see Abstracts 4817 (1932) and 893 (1933)], the author presents rapidly converging series for a complete discussion of the problem of free electrons in metals. A slight correction to previous work is referred to, but the conclusions are unaffected. J. S. G. T.

1339. Indeterminacy in Quantum Mechanics. J. Solomon. *J. de Physique et le Radium*, 4. *pp.* 34–37, *Jan.*, 1933.—It is shown that an attempt to take into account the Heisenberg uncertainty principle in quantum mechanics by means of a theory involving supplementary or undetermined parameters leads to results mathematically incompatible with the uncertainty principle. N. M. B.

1340. Multiplication of Quantum-Mechanical Quantities. P. Jordan. *Zeits. f. Physik*, 80. 5–6. *pp.* 285–291, *Jan.* 31, 1933.—The physical significance of the non-commutative, associative multiplication of quantum-mechanical magnitudes is discussed. J. S. G. T.

1341. Interaction between Atoms with *s*-Electrons. N. Rosen and S. Ikehara. *Phys. Rev.* 43 *pp.* 5–8, *Jan.* 1, 1933.—The formulæ for the interaction between two identical atoms with an outer *s*-electron of arbitrary quantum number as developed by Rosen in several earlier papers [see Abstracts 3356 (1931) and 1509 (1932)], are evaluated numerically. The results are presented in the form of graphs which show the shape of the Coulomb, exchange, and singlet energy curves for various values of the quantum number and how their minima vary with the latter. Curves from which the fundamental molecular constants may be read are included. A table of calculated constants for hydrogen and the alkali-metal molecules is presented and comparison made with experimental values, fair agreement being obtained. **Authors.**

1342. Applications of the Method of Impact Parameter in Collisions. E. J. Williams. *Roy. Soc., Proc.* 139. *pp.* 163–186, *Jan.*, 1933.—A *light* collision is one in which the transfer of momentum is small compared with the momentum of the moving particle, so that any reaction on the latter can be neglected. Thus a light collision between a moving particle and an atom is represented in the wave equation of the atom, by a perturbation potential, corresponding to a Coulombian field whose origin moves with velocity v on a straight line of perpendicular distance p (the impact parameter) from the nucleus of the atom. The method of impact parameter is applied to the following problems: (*a*) Distant collisions (*i.e.*, collisions in which p is appreciably greater than atomic dimensions). The rate of loss of energy of a high velocity particle traversing an atmosphere containing N atoms per cc. is calculated and Gaunt's conclusion that classical and quantum theories yield about the same dissipation is confirmed. When a collision results in an energy transfer, the amount of the latter is always in the neighbourhood of the ionisation energy J. (*b*) Relativity effect in light collisions. The increase in the dissipation of energy when the Fitzgerald contraction of the field of the moving particle is allowed for, is worked out. (*c*) Distant collisions and photoelectric effect of radiation. The effects of a distant collision are correctly reproduced by resolving the perturbing force into its Fourier components and assuming each component to behave like radiation of the same frequency. (*d*) Spatial distribution of the excited and ionised atoms with respect to the path of the particle. It is found that up to distances of the order of ρ cm. from the path of the particle, ions and excited atoms are produced with appreciable frequency, but for larger distances the number produced is negligible. ρ (radius of action of the particle) is given by

$$\rho = 0{\cdot}2\,\mathrm{vh}/\mathrm{J}(1-\beta^2)^{\frac{1}{2}}.$$

For a 100,000 V. electron in hydrogen, about 85% of the inelastic collisions occur when the path of the electron is at least 1 Å from the hydrogen nucleus. Of the total loss of *energy* about half takes place in distant collisions in which the electron may be said to pass outside the atom. W. S. S.

1343. Relativistic Theory of Particles with Arbitrary Intrinsic Momentum. E. Majorana. *N. Cimento*, 9. *pp.* 335–344, *Dec.*, 1932.—Dirac's relativistic linear wave-equation applies only to particles with intrinsic momentum $\frac{1}{2}h/2\pi$. A wave-equation, analogous in form to Dirac's, but more general, is established which permits of the consideration of particles with arbitrary angular momentum. A. J. McC.

See also Abstracts 1324, 1345, 1493, 1507, 1638.

RELATIVITY AND ETHER.

1344. Clock Problem in Relativity. J. W. Campbell. *Phil. Mag.* 15. *pp.* 48–51, *Jan.*, 1933.—It is proved that if a clock X moves in a Galilean frame of reference (where gravitational fields are defined by their potentials) over any closed path and in any manner, then between any two passages through the same point with the same velocity, the gains, as seen by an observer moving with X, of all clocks at rest in the

Galilean frame and not in the vicinity of matter are the same. These gains are precisely equal to the loss of the clock X as seen by observers stationed with the other clocks. G. C. McV.

1345. Unitary Field Theory and Dirac's Equations. W. Pauli and J. Solomon. *J. de Physique et le Radium*, 3 *pp.* 582–589, *Dec.*, 1932.—Completes and rectifies the authors' previous work [see Abstract 491 (1933)]. Examines the theory of spinors in five dimensions, and discusses the form of the energy momentum tensor and the current vector in the Einstein-Mayer theory. The introduction of supplementary terms in the wave equation is physically not very satisfactory, and the theory of Schouten and van Dantzig [see Abstracts 102, 103, and 104 (1933)] may be preferred. E. E. F. d'A.

1346. Gravitation and Electricity. Part II. Irene E. Viney and Grace G. Leybourne. Part III. H. F. Willis. *Phil. Mag.* 15. *pp.* 33–48 *and* 130–143, *Jan.*, 1933.—A unified field theory is developed based on the assumption that gravitational attraction between particles of matter is due to the existence of a property called "gravity" which is analogous to electric charge. The field equations are found using variational methods. Detailed calculations for the cases of a spherical shell and of a solid sphere lead to the conclusion that their energy, momentum and inertia are all negative. Explanations are offered to account for this discrepancy with observation. [For Part I see Abstract 4824 (1932).] G. C. McV.

1347. World-Structure and the Expansion of the Universe. E. A. Milne. *Zeits. f. Astrophysik*, 6. 1–2. *pp.* 1–96, *Jan.* 18, 1933. *In English.*—If a set of particles moving in any manner occupies the interior of a sphere S which is surrounded by empty space, the particles will necessarily form an expanding system of particles after a sufficient lapse of time, as viewed from the centre of the distribution. If a set of observers employ Euclidean space-time frames whose space-time origins coincide with the initial centre of the swarm of particles, each observer will see the swarm centred around himself whatever his velocity with respect to other observers may be. The distribution function for the particles is obtained on the basis of special relativity together with the added axiom that the events occurring in the world, as well as the laws governing them, must appear the same to all observers. Generalisations of this scheme to the case when the region outside S is not empty and also to take account of the gravitational attraction of the particles are considered. Applied to the system of the spiral nebulæ, this theory gives a time-lapse of 2×10^9 years since the expansion effectively began. The paper is also partly devoted to criticisms of the current theory of the expanding universe which is based on the general theory of relativity. G. C. McV.

1348. E. A. Milne's Theory of the Expansion of the Universe. E. Freundlich. *Naturwiss.* 21. *pp.* 54–59, *Jan.* 27, 1933.—A non-mathematical account of E. A. Milne's kinematical theory for accounting for the recession of the spiral nebulæ [see preceding Abstract]. G. C. McV.

See also Abstract 1368.

SOLUTION.

1349. Heats of Solution of Gases. J. Horiuti. *Zeits. f. Elektrochem.* 39. *pp.* 20–22, *Jan.*, 1933.—Heats of solution of gases in liquids are usually calculated on the assumption that the volume of the solution is independent of temperature. Formulæ are here derived for the variation of the heats of solution with concentration, taking account of possible variation. In the case of solutions in CCl_4 at 25°C, the heats of solution at constant pressure, newly calculated, are 220 cal./mol. smaller. Heats of solution at constant volume are also affected. J. P. A.

1350. Relation between Solubility and Diffusion of Gases in Liquids. J. Horiuti. *Zeits. f. Elektrochem.* 39. *pp.* 22–24, *Jan.*, 1933.—From an accurate knowledge of solubility [see Abstract 1349 (1933)], the coefficient of diffusion of a gas in a liquid may be calculated approximately. A formula is derived on these lines. For hydrogen dissolved in C_6H_6, at 25°C, the value of the coefficient thus derived is 3×10^{-5}cm.^{2}/sec. J. P. A.

1351. Solubility of Lithium in Liquid Ammonia. W. C. Johnson and M. M. Piskur. *J. Phys. Chem.* 37. *pp.* 93–99, *Jan.*, 1933.—The solubility of lithium in liquid ammonia has been determined from vapour-pressure measurements. It increases with rise of temperature, being 11·319% at 0° and 10·698 at − 63·5°C. A. S. C. L.

1352. Absorption Velocity of Gases by Liquids. Parts II & III. S. Hatta. *Tohoku Univ. Technol. Reports*, 10. 4. *pp.* 119–168, 1932. *In English.*—The velocity of absorption of CO_2 by potassium hydroxide and carbonate solutions has been determined. Equations are derived to show the mechanism of the reactions at the interface and in bulk, and are in fair agreement with the experimental data. [For Part I see Abstract 1686 (1929).] A. S. C. L.

See also Abstracts 1539, 1607.

SURFACE TENSION AND COHESION.

1353. Theory of Surface Tension of Dilute Electrolytes and the Structure of the Surface Skin. S. Oka. *Phys. Math. Soc., Japan, Proc.* 14. *pp.* 649–664, *Dec.*, 1932. *In German.*—Starting on a thermodynamic basis the increase of surface tension $\Delta\sigma$ due to the solution of an electrolyte in a solvent is derived with the help of Debye and Hückel's electrolytic theory and Lewis and Randall's expression for the ionic strength. $\Delta\sigma$ is found to be proportional to the concentration. The substitution of numerical data in the derived relation yields values of $\Delta\sigma$ in agreement with observed values. An expression is also derived for the concentration of the electrolytic ions in the neighbourhood of the surface of the solutions, from which it follows that the concentration is zero within about 0·5 Å of the surface, and increases to the full concentration in the body of the liquid at about 20 Å from the surface. P. H. B.

1354. Interfacial Activity and Orientation of Polar Molecules. Part IX. Applicability of Antonov's Rule, Particularly to Adsorbed Films. A. Taubmann. *Kolloid Zeits.* 62. *pp.* 76–78, *Jan.*, 1933.—Antonov's rule is not applicable to the interfacial film formed by a benzene or hexane solution of *p*-toluidine in contact with water; in general, σ_{12} is considerably less than $\sigma_1{}^1-\sigma^1{}_2$. Also, for pure liquids only slightly soluble in water, considerable deviations are found between the observed values of $\sigma_1{}^1$ and those reported by Antonov and Reynolds. Addition of sodium or potassium hydroxides to a water-benzene system increases the interfacial tension. H. F. G.

1355. Calculation of Surface Tension from Experiment. Part I. Sessile Drops. A. W. Porter. *Phil. Mag.* 15. *pp.* 163–170, *Jan.*, 1933. —The published data for the calculation of surface tensions from observations on sessile drops are reviewed. For large drops the formula developed by Rayleigh, together with his correction for the curvature at the mid-point, is accepted. For small drops there are the tables prepared by Bashforth and Adams. It is shown theoretically, and also from the tables, that the simple formula $\beta^2/r^2 = h^2/2r^2$ applies not only to very large drops, but also to certain medium sized drops. An equation based on graphical connection between Rayleigh's and Bashforth and Adams's results is derived for accurate calculations from medium sized drops. The results are compared with those given by the formulæ of Ferguson and Worthington. Some notes on the reliability of the sessile drop method of determining surface tensions are added. P. H. B.

1356. Shape of Profiles of Liquid Films Draining on a Vertical Wetted Plate, and An Investigation of the Plate Ridge. J. Satterly and E. L. Stuckey. *Roy. Soc. Canada, Trans.* 26. *pp.* 131–161, *May*, 1932.—Interference fringes formed by reflection of monochromatic light from films draining on a glass plate in an enclosed space were photographed. Vertically down the middle of the plate the profiles of the films were shown in many cases to be parabolic by plotting the order of the fringes against the distance down the plate. This is in accordance with H. Jeffreys' theoretical formula [see Abstract 2995 (1930)] according to which gravity and viscosity control the drainage. It is suggested that such discrepancies as were found are due to the difficulty of measuring the required constants in the film itself. Horizontally across the plate there is a rapid increase from zero thickness at the edge, followed by a less rapid decrease to a constant thickness reached within about a centimetre from the edge of the plate. The plate ridge was also investigated by the interference method, and it was shown that in general the thickness of the film increases continuously on passing down the plate through the ridge, there being a relatively large increase in thickness at the ridge. Below the ridge the surface of the water is covered by the contaminating liquid, but the conclusion is reached that the sudden increase in thickness at the ridge is largely caused by underlying water. Numerous photographs are reproduced. P. H. B.

1357. Spreading of Liquids on Solid Surfaces. R. Bulkley and G. H. S. Snyder. *Am. Chem. Soc., J.* 55. *pp.* 194–208, *Jan.*, 1933.— In spite of the greater interfacial tension between metals and mineral oils, they spread without limit on steel surfaces whereas fatty oils and acids, whose interfacial tension is less, do not spread in visible amount. This is due to the formation of a very thin layer sufficient to reduce the free interfacial surface energy to a minimum so that further bulk spreading would mean an increase of the free surface energy of the oil. The thin film forms in advance either by breaking away from the bulk or by condensation of vapour. Fatty oils and acids are preferentially adsorbed from solution in mineral oils. A. S. C. L.

1358. Properties of the Becquerel Membranes. J. J. Bikerman. *Kolloid Zeits.* 62. *pp.* 26–31; *Disc.*, 31, *Jan.*, 1933.— This paper continues a previous investigation [see Abstract 2891 (1931)] and investigates the phenomenon that the current through the pores of a partition separating a solution of silver nitrate from one of sodium sulphide is always in the direction of former to latter, and that the membrane formed in the pores is semi-permeable. The porosity of this silver sulphide membrane is examined, and its relation to the membrane potential is discussed. H. H. Ho.

1359. Membrane Processes. K. Söllner. *Kolloid Zeits.* 62. *pp.* 31–37, *Jan.*, 1933.—This paper describes experiments for the explanation of Becquerel phenomena, negative osmose, and abnormal permeabilities of membranes consisting of precipitates formed by the interdiffusion of copper, silver, mercury, lead, nickel or cobalt salts and sodium sulphide, selenide and telluride. H. H. Ho.

1360. Measurement of Surface Tension. T. C. Sutton. *Phys. Soc., Proc.* 45. *pp.* 88–90, *Jan.* 1, 1933.—A convenient method is described for measuring simultaneously the surface tension and the density of a sample of liquid. A few milligrams of liquid will suffice. The method has advantages, therefore, for the measurement of the parachors, $\gamma^{\frac{1}{4}}/\rho$, of rare liquids. Volatile liquids may be used. AUTHOR.

1361. Surface Tension Balance. R. J. DeGray. *Indust. and Engin. Chem.* (*Analytical Edition*), 5. *pp.* 70–73, *Jan.* 15, 1933.—A torsion balance for the determination of surface tensions is described. The load is carried by two springs, and the balance adjustment for any change in gravity acting on the load, or in the length of the spring, is effected by varying the length of the balance arm. The theory and method of using the balance are given. F. J. B.

1362. Bubble Formation in Glass Tubes. W. B. Mann and R. W. B. Stevens. *Phil. Mag.* 15. *pp.* 143–146, *Jan.*, 1933.—Systems of bubbles were formed in an inclined glass tube of diameter about 2 cm. by allowing air to bubble through various liquids contained in a narrower tube sealed to the lower end. The systems are described, and photographs are reproduced. P. H. B.

See also Abstracts 1269, 1386, 1538, 1559.

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

1363. Influence of Tremors on Chronometer Rates. G. P. Arcay. *Comptes Rendus*, 196. *pp.* 97–99, *Jan.* 9, 1933.—It was found as a result of tests that (1) loss of amplitude of the oscillations of the balance was a function of the frequency of the tremors, and (2) an increase of the period of the oscillations always remains after suppression of the vibrations. Retardation of the chronometer is not due to deformation of the spiral under the influence of resonance because this would give rise to a gain. The chronometer spiral has its tension changing at each instant during the oscillation and its true period varies periodically and very rapidly since the period of the balancing system is 0·4 sec. These results are illustrated by experimental values obtained with a steel spiral. [See also Abstract 1392 (1929).] R. S. R.

1364. Free-Pendulum Clock. G. A. Tomlinson. *Phys. Soc., Proc.* 45. *pp.* 41–47 ; *Disc.*, 48, *Jan.* 1, 1933.—A new method of taking accurately defined seconds signals from a pendulum is described, in which a photoelectric cell is used in conjunction with a special arrangement of multiple slits. This has been developed into a complete free-pendulum system, self-maintained *in vacuo* by means of electrostatic impulses and having a closely governed arc. AUTHOR.

ASTRONOMY AND ASTROPHYSICS.

COMETS AND METEORS.

1365. Orbit of Comet 1917 II (Mellish). S. Asklöf. *Arkiv f. Mat. Astron. och Fysik, Stockholm,* 23. 2. *pp.* 1–16, 1933. *In English.*—In 1923 an orbit was computed from 239 visual and 106 photographic observations spread over a period of 97 days. A slight tendency to systematic differences between visual and photographic observations made it advisable to redetermine the orbit from both sets separately. Before and immediately after perihelion the photographic observations place the comet nearer the sun than the visual, but later on at great distances from the sun the opposite is the case. It is possible that this is due to effects of differences in temperature in different parts of the comet. The comparison of the different sets of observations shows that the elements from the visual are almost identical with those from the combined material, but those from the photographic differ somewhat. On account of the good internal agreement of the photographic observations, the elements derived from these should probably be regarded as the final definitive elements. M. A. E.

COSMOGONY.

1366. Origin of the Solar System. F. Nölke. *Roy. Astron. Soc., M.N.* 93. *pp.* 159–161, *Dec.,* 1932.—The author replies to Jeffreys [see Abstract 128 (1933)], explaining his reasons for not accepting the collision theory. His own analysis of the possibilities of development of our planetary system leads to the conclusion that it arose from a widely-spread nebula having shape and structure and splitting up into several parts which conglomerated to form sun and planets. The pressure of radiation at first nearly compensated gravitation in the nebula, but gradually decreased when the masses contracted. Favourable conditions of development existed for the regular satellites in the interior of the planetary atmospheres, which, at high temperatures and extending beyond the present orbits of the satellites, together with the planetary core, formed a whirl, the masses of which described free circular orbits in a defined ring-area of the equatorial plane. M. A. E.

See also Abstract 1468.

LATITUDE AND LONGITUDE.

See Abstracts 1368, 1395.

NEBULÆ.

1367. Radial Velocity of Some Nebulæ. C. Sola. *Comptes Rendus,* 196. *pp.* 249–251, *Jan.* 23, 1933.—The author seeks an explanation for the spectral displacement to the red according to distance for distant nebulæ, and conceives luminous filaments of corpuscles or photons endowed with ballistic velocity of 300,000 km./sec. with respect to the luminous focus, such corpuscles having an undulatory motion of an elastic kind propagated along the filament with a velocity of the same order as the other. The number of photons diffused at any moment is proportionate to the quantity ϕ of photons in unit length of the luminous filament at a coefficient k ($e^k = \alpha$, the coefficient of diffusion) and to the differential of the distance δ of the focus to the point considered, so that $\phi = a\delta$. Since it is found observationally that the spectral displacement is proportional to the distance of the focus, if the value of a were known with precision, and the true radial velocity of the nebula or star were neglected, the distance of far objects could be calculated directly. **Errata,** *ibid.*, p. 512, Feb. 13, 1933. A. S. D. M.

See also Abstracts 1347, 1348.

PLANETS.

1368. Hornsby's Observations of Mercury, 1774–1798. J. Jackson. *Roy. Astron. Soc., M.N.* 93. *pp.* 116–130, *Dec.*, 1932.—The first three Radcliffe observers (Hornsby, Robertson and Rigaud) observed assiduously from 1774 till 1838, but their observations were reduced only recently. They include observations of Mercury of which 103 are between 1774 and 1778, 106 between 1779 and 1784, and 140 between 1790 and 1798; and should determine well the orbital elements of 150 years ago, and especially should form a check upon its perihelion motion. The tabular values of Mercury needed to be of the accuracy of Newcomb's tables. There is uncertainty from defective illumination, for there is marked phase at maximum elongation and it is not always indicated as to what point an observer takes as the "centre of illumination." Hornsby seems to have estimated at the telescope, in the case of Venus, the geometrical centre of the complete disc, but it is doubtful whether he did the same in Mercury's case. The author gives a table of residuals without the application of any correction for defective illumination, and discusses the unknowns which should be introduced in analysing these residuals. Theoretically, corrections should be introduced in all orbital elements of both planet and earth and to the R.A. and Dec. of Boss's Standard stars also. He considers not only these, but also the longitude of the sun, and the equinox, the rotation of the earth, the obliquity of the ecliptic, the equator point, and the perihelion of Mercury. For this last, he finds for the difference between the observed motion and the Newtonian theory, a value of $43''\cdot 1 \pm 1''\cdot 0$ per century, which is in close agreement with that of $42''\cdot 9$ given by the general theory of relativity.

A. S. D. M.

1369. Photometric Theory of Lunar Eclipses. F. Link. *Comptes Rendus,* 196. *pp.* 251–253, *Jan.* 23, 1933.—Lunar eclipses provide a convenient method for tangential sounding of the atmosphere, as compared with the radial sounding by means of stars near the horizon. Adopting J. Humphreys' function of atmospheric density from 0 to 40 km., the author calculates by a numerical process the horizontal refraction, the variation with altitude and the air mass for each kilometre between 2 and 40, and thus obtains the optical densities of the shadow on a given principle so that the calculation is reduced to the shadow produced by a point source. He finds an absorbing layer of density 0·04 at the zenith, situated at an altitude of 150 km., and that the absorption by the ozone layer for horizontal rays begins to decrease at about 20 km. altitude.

A. S. D. M.

See also Abstracts 1314, 1366, 1503.

STARS.

1370. Dynamical Parallaxes of Double Stars. D. Barbier. *Comptes Rendus,* 196. *pp.* 253–255, *Jan.* 23, 1933.—The author has indicated [see Abstract 1171 (1932)] that theoretically the formulæ for dynamical parallaxes are erroneous, and that the numerical results are false. W. S. Finsen has thrown doubt on these conclusions, and the author gives arguments that so far from refuting, Finsen's work confirms him. A. S. D. M.

1371. Theory of Streaming in B-Type Stars. K. F. Bottlinger and K. Ogrodnikoff. *Zeits. f. Astrophysik,* 6. 1–2. *pp.* 150–153 *and* 154–160, *Jan.* 13, 1933.—Bottlinger puts forward two objections to Ogrodnikoff's theory of streaming of B-type stars [see Abstract 3198 (1932)]. The latter replies, pointing out that the objections arise through a confusion in the use of terms. G. C. McV.

1372. Four Stars whose Spectra have Bright Helium Lines. P. W. Merrill. *Mt. Wilson Observat. Contrib. No.* 460. *Astrophys. J.* 77. *pp.* 44–50, *Jan.,* 1933.—Emission lines of H, He I, He II, N III, C III?, [OIII], and the unidentified nebular lines λ 3869 and λ 3968 are present in the spectra of one or more of the faint stars AX Persei, RW Hydræ, CI Cygni, and MW 143. In the first three, bright λ 4686 He II is combined with dark bands of TiO; these three objects are variable in light and resemble Z Andromedæ. Radial velocities have been derived from the bright lines. The anomalous combination of bright lines requiring high excitation with dark bands of TiO appears to result from a definite set of conditions among which low pressure is probably essential. AUTHOR.

1373. Bright Sodium Lines in a Stellar Spectrum. P. W. Merrill. *Mt. Wilson Observat. Contrib.* 20. 461. *Astrophys. J.* 77. *pp.* 51–55, *Jan.,* 1933.—This spectrum, type Aoep, has bright sodium lines, D1,2. Both H and K of calcium, in addition to a narrow dark line in the normal position, have an intense dark component 3 Å wide, displaced 3·2 Å toward shorter wave-lengths. The narrow lines have bright fringes on either side. Numerous enhanced metallic lines, most of them in emission, are visible. The radial velocity is about 0 km./sec. Neither the spectral details nor the integrated light have been observed to vary. AUTHOR.

1374. Emission Line of Hydrogen in the Spectrum of Rigel. O. Struve. *Astrophys. J.* 77. *pp.* 67–68, *Jan.,* 1933.—The spectrum of β Orionis (B8p) shows a peculiar line at $H\alpha$. The absorption line is weak, and is shifted about 1·0 Å toward the violet with respect to $H\beta$, which is normal. On the red side of absorption $H\alpha$ is a faint and narrow emission line which is shifted about 1·5 Å toward the red from the normal position of $H\alpha$. AUTHOR.

1375. Theory of the Darkening at the Limb for β-Lyræ Stars. W. Krat. *Zeits. f. Astrophysik,* 6. 1–2. *pp.* 96–106, *Jan.* 18, 1933.—The coefficient giving the darkening at the limb for eclipsing variables of this type is calculated, allowance being made for the ellipticity of the component stars. G. C. McV.

1376. Hydrogen Line Intensities in Praesepe. Y. Öhman. *Arkiv f. Mat. Astron. och Fysik, Stockholm,* 23. 2. *pp.* 1–6, 1933. *In English.*—The total absorption of hydrogen lines $H\gamma$ and $H\delta$ are measured for stars down to $10^{m}\cdot 3$, the faintest star being No. 222 in Klein-Wassink's catalogue, and only the stars 556, 293, 548 and 495 besides the late-type giants being omitted. Three figures are given. The first indicates that the brightest stars show too advanced spectral types; for Praesepe the spectral class is not very significant as regards the luminosity for high-temperature stars; from the line intensity measures it is seen that all the Praesepe stars belong to the low-temperature branch in the relation between hydrogen line intensity and colour, as has been found elsewhere. The second figure evidences a pronounced correlation between photographic magnitude and total absorption for both Hγ and Hδ, but this is not quite independent of colour (compare the Greenwich zone stars); the fainter stars probably show the Hertzsprung-Russell relation, but the brighter show a colour influence reminiscent of Milne's real luminosity effect. The third figure gives the intensities of Hγ and Hδ in low temperature star distribution for the Greenwich zone, for Praesepe and for the Pleiades clusters; the first indicates two different minima corresponding to 0·38 and 0·48 in Hγ; one only at 0·38 in Praesepe, and one possibly at the second minimum in the Pleiades (here the stars measured are few). The author says that this phenomenon may have a cosmogonical origin. [See also Abstract 4878 (1932).] A. S. D. M.

1377. Study of Star Colours and Magnitudes in Open Cluster Messier 38 (N.G.C. 1912). Å. Wallenquist. *Arkiv f. Mat. Astron. och Fysik, Stockholm*, 23. 2. *pp.* 1–15, 1933. *In English.*—A photographic-photometric study of 210 stars in or near Messier 38 { constellation, Auriga, R.A. = 5^h. 22^m. 0, $\delta = +35° 45'$ (1900) } or galactic longitude and latitude, 14°·0 and + 2°·0. Its diameter is variously found as 20′ (Melotte and Shapley), 44′ (Raab), 25′ (Collinder), 18′ (Lundmark and Trumpler); its distance in parsecs, 870 (Trumpler), 1270 (Collinder). The material is derived from two photographic and two photo-visual plates (yellow filter GG11, transmitting $\lambda > 500\mu\mu$). Tables give the plate data, polar stars corrections, and systematic errors. For statistical purposes the region is divided into two parts: Cluster region (within 9′·5 of centre); external region (9′·5–22′·0). Tables give the distribution of stars according to colour and apparent photo-visual magnitude. A diagram shows that the cluster has a large percentage of white stars brighter than photo-visual magnitude 12·80; that there are two pronounced maxima for whose tops the mean absolute magnitudes are + 0·49 and + 2·30, from which the distance is inferred as 1096 and 1005 parsecs, with mean value 1064 + 38. A catalogue of the stars is given. A. S. D. M.

1378. Mean Light Curves of Long Period Variable Stars. Part XI. R. Ursæ Majoris. A. A. Nijland. *K. Akad. Amsterdam, Proc.* 35. 10. *pp.* 1230–1234, 1932. *In German.*—The period of this star, deduced from 741 observations made between 1905 and 1932, is 299^d·8, so it has shortened since Chandler and v. Müller made their observations which give a mean period of 302^d·1. The maximum brightness is 7^m·46, the minimum 12^m·98. The mean curve is perfectly smooth, without any trace of a hump in the ascent, and it much resembles those of W. Herculis, S. Boötis, and T. Ursæ majoris. M. A. E.

See also Abstract 1366.

SUN.

1379. Relative Distribution and Abundance of Elements in the Lower Chromosphere. S. A. Mitchell and Emma T. R. Williams. *Astrophys. J.* 77. *pp.* 1–43, *Jan.*, 1933.—The general method is described, and 56 lines of Fe I and II, Ti II, Cr II and Sc II, are used. *Eh* indicates the amount of energy emitted by atoms of given type along lines of sight corresponding to the height, *h*, in km., and a table is given of the 56 lines for $\log \{ Eh/(Eh + \Delta h)\}$ and another summarising the results. Calculating the relative energy according to assumed density laws, there is found no possibility for total support by radiation pressure of Ti II, Fe II, etc., but some probability for partial support. The density gradients for all elements are of the same order, indicating turbulence as a responsible factor; for other elements than the four in the chromosphere it is possible to get qualitative results only for density gradients. Most of the emitting helium atoms are more than 600 km. above the photosphere; the He I lines of a given I_{1000} rise to greater heights than those of any other elements of the same level I_{1000}. Above the level I_{600} there is very little difference between the density gradient of H and Ti II; the ionised elements are generally similar to Ti II. Ultimate lines of neutral elements show smaller density gradient than the average lines of the same element. Mg I shows a less density gradient above I_{1000} level than any other element observed except helium; at this level Mg II and Ca II are largely supported by radiation pressure; at λ2800 Mg II is higher than H and K. Tables are given of relative abundance from intensity estimates; H is deficient in the earth's crust and in meteorites, but abundant in the chromosphere. Menzel's results conflict with the author's in temperature determination and in density gradients and especially in the abundance of rare earths. [see also Abstracts 2475 (1930), 72 and 73 (1931), and 1899 (1932).]

A. S. D. M.

1380. Values of the Constants of the Saha Equation. R. T. Birge. *Astrophys. J.* 77. *pp.* 63–65. *Jan.*, 1933.—The two general constants contained in the Saha equation are calculated using the most recent values of the fundamental physical constants they involve. The values are $5040 \cdot 5 \pm \cdot 69$, instead of the usual 5048, and $- 6 \cdot 48016 \pm 0 \cdot 00056$, instead of $- 6 \cdot 5$.

G. C. McV.

See also Abstract 1650.

ZODIACAL LIGHT AND GEGENSCHEIN.

1381. Photometry of the Gegenschein. C. T. Elvey. *Astrophys. J.* 77. *pp.* 56–62, *Jan.*, 1933.—The sky background in the region containing the Gegenschein has been measured with the photoelectric photometer attached to the 40-inch telescope of the Yerkes Observatory. These measurements furnish sufficient data to separate the illumination which is due to the Gegenschein from that which arises from the light scattered in the atmosphere. The observations were made on the nights of September 25, 28, and October 1, each at about six hours U.T., and the results are shown in the form of diagrams by plotting the observations and drawing the isophotes. The changing form and position of the Gegenschein is evident. The integrated brightness of the Gegenschein is equivalent to stars of photographic magnitudes $+ 0 \cdot 52$, $- 0 \cdot 06$, and $- 0 \cdot 28$, respectively, for the three dates. The central brightnesses per square degree are, respectively, 6·54, 6·51, and 6·22 mag. [See also Abstract 4190 (1932).]

AUTHOR.

GEOPHYSICS.

GEOPHYSICS, APPLIED.

1382. Elastic Constants of Rocks, with a Seismic Application. T. C. Richards. *Phys. Soc., Proc.* 45. *pp.* 70–79; *Disc.*, 79–81, *Jan.* 1, 1933.—The results of a geophysical survey by means of the seismic method over a large oil-bearing limestone structure in south-west Persia indicate that the limestone possesses a higher elastic velocity at its lower boundary than at its upper. Specimens of the limestone at different depths obtained by coring do not give the same elastic constants when measured by a simple optical method, and the bearing of this result on the practical seismic observation is discussed. AUTHOR.

See also Abstract 1397.

HYDROSPHERE, PHYSICS OF THE.

1383. Apparatus to Measure and Record Vertical Submarine and Sub-Lake Currents. Idrac. *Comptes Rendus*, 196. *pp.* 126–127, *Jan.* 9, 1933.—The apparatus consists of a helix with a vertical axis. It has a special mounting such that, with a perfect symmetry of form around the horizontal axis, and a large asymmetry of weight, the axis of the coil is absolutely vertical for all currents. It is unaffected by horizontal currents. It can move only if the current is a vertical component and its speed of rotation is proportional to it. The apparatus is suspended from a boat and connected to a Wheatstone bridge. Currents of even 3 cm./sec. can be detected at several hundred metres depth. At Gibraltar vertical currents have been found at a depth of 220m. which show the interaction of currents from the Mediterranean and the Atlantic. R. S. R.

LAND, PHYSICS OF THE.

1384. Earth Structure. E. A. Hodgson. *Roy. Astron. Soc., Canada, J.* 27. *pp.* 1–10, *Jan.*, 1933.—A summary of the methods of using seismic data to determine the internal structure of the earth below its outer crust. W. A. R.

1385. Depths of the Earth. R. A. Daly. *Science*, 77. *pp.* 95–102, *Jan.* 27, 1933. *Presidential Address to the Geolog. Soc. of America.*—This address is a summary of the stratification of the earth's crust, and the bearing of such on the problems of isostasy, etc. W. A. R.

1386. Application of Boltzmann's Principle to Certain Kinds of Movement. G. I. Pokrowski. *Zeits. f. Instrumentenk.* 14. 2. *pp.* 67–69, 1933.—A displacement E, such as that due to the sinking of a solid mass in a plastic body, is found to be expressible as a function of the time t in the form: L log $(\rho t + 1)$, where L and ρ are constants. Experiments made on the sinking of heavy loads on a building site, on the deformation of a clay cylinder under load, and on the capillary movement of water in clay gave good agreement with the theoretical relation. R. F. A.

See also Abstracts 1318, 1395, 1412, 1616.

METEOROLOGY.

1387. Physics in Meteorology. G. C. Simpson. *Physics in Industry, Lecture No.* 18 [21 *pp.*], 1933.—The author shows by example how the various branches of physics, sound, light, heat, magnetism and electricity, may be used to solve problems in meteorology. The zones of audibility and the zones of silence experienced round the position of a large explosion have been used to determine the temperature at heights of 40 to 55 km. above the earth's surface. Close investigation of the absorption band due to ozone has been instrumental in determining the seasonal distribution of ozone in the upper atmosphere over the surface of the earth, and likewise its distribution in relation to the cyclones and anticyclones of mean latitudes. Proof is given that the effective solar radiation ultimately leaves the earth again as long-wave terrestrial radiation, the author's calculation of the latter agreeing to within 2 % of the known incoming radiation. Curves are drawn for both incoming and outgoing radiation. The curve for outgoing is such that it indicates that the outgoing radiation is the same in all latitudes. This is rendered possible through the transfer of heat from the equator to the poles, a fact recognised for long, but the position is now such that quantitative values can-be used in these problems. Only a minor part has been played by magnetism in meteorological problems up to the present. On the other hand atmospheric electricity has engaged considerable attention on the part of physicists. The two main problems, (*a*) the maintenance of the earth's field, and (*b*) the ionisation of the lower atmosphere, are discussed, and the present position as regards the solution of these problems is indicated. A. E. M. G.

1388. Measurement of Visibility at Night. W. E. K. Middleton. *Roy. Soc. Canada, Trans.* 26. *pp.* 25–33, *May*, 1932.—The present paper extends the results from a former investigation [see Abstract 1535 (1932)]. Details are supplied regarding the dimensions and contruction of the instrument used and its adjustments for use. Calibration may be performed by (1) accurate photometry of the standardising lamp, or (2) finding the effective illumination of a bright star. Possible errors in measuring the distance of visibility and the opacity of the atmosphere are discussed. A series of eye and instrumental observations of the visibility across water of street lamps at various distances up to 15 km. was made in Toronto. The agreement was good up to 3 km. where accuracy is most important, but the instrument often gave the lower figure. R. S. R.

1389. New Sort of Wind-Rose. N. Shaw and L. G. Garbett. *Roy. Meteorolog. Soc., J.* 59. *pp.* 39–43; *Disc.*, 43–44, *Jan.*, 1933.—To represent frequencies of wind speed and direction a step diagram is used which shows for each of the 12 months, according to the 8 main directions, the frequencies of wind speeds of Beaufort force 8 or more by a black portion, for forces 4–7 a rectangular portion, and for forces 1–3 a line. The number of calms is shown by figures. Six examples are shown. On the diagram the direction of the prevailing winds, and their seasonal and directional changes are seen readily. The method avoids

V.3
193

the necessity of individual charts for each month and would be invaluable also for indicating wind frequencies for different heights. R. S. R.

1390. Katabatic Winds in a Valley. G. S. P. Heywood. *Roy. Meteorolog. Soc., J.* 59. *pp.* 47–57; *Disc.,* 57–58, *Jan.,* 1933.—Observations were made in the Cotswolds, near Leafield, of the wind speed and direction recorded in a valley, and on the open ground above it, the two stations having a height difference of 220 ft. It was found that the katabatic flow might start at any part of the night, but mostly begins before midnight, while the average duration does not exceed 3 hours. The hourly mean velocity in the valley exceeds that in the open by about 1½ m./sec., while the gustiness factor is from 0·2 to 0·25. The most favourable conditions found were a light wind in the open ($\not>$ 5 m./sec.) and a clear sky for some hours. It occurs when, or soon after, the valley temperature falls most rapidly and with an inversion above the high ground of 1°–5°F, from 4 to 100 ft., but seldom when the inversion exceeds 5°F. It is often followed by fog, and ceases when the cold air accumulates in the hollows of the valley. Its depth in the early stages is small, but it increases as the flow continues. R. S. R.

1391. Smoke Particles and Condensation Nuclei at Kew Observatory. H. L. Wright. *Meteorolog. Office, Geophys. Mem. No.* 57. [22 *pp.*], 1932.—Observations relating to smoke particles and condensation nuclei have been analysed for the period 1928–1930. Smoke particles show (1) an annual variation amounting to 1367/cc. in the winter half year and 180/cc. in the summer half year; (2) a maximum for E winds; (3) an excess for light winds; (4) an excess for relative humidity $> 80\%$; and (5) only slight variation with cloud amount. The average radius of the smoke particle, assumed spherical, is from 3×10^{-5} to 4×10^{-5}cm. Condensation nuclei show (*a*) small range of annual variation; (*b*) an excess for winds NNE to ESE; (*c*) an excess for strong winds and for winds $<$ 2m./sec.; (*d*) maximum concentration for high and low relative humidity; (*e*) an inverse relation with vapour pressure; and (*f*) slight or no variation with cloud amount. Correlation coefficients between smoke particles and condensation nuclei show for (1) all observations $\cdot 69 \pm \cdot 04$; (2) winter $\cdot 71 \pm \cdot 05$; and (3) summer $\cdot 25 \pm \cdot 10$. Distinguishing nuclei from smoke and other sources shows that in winter ⅜ of the nuclei at Kew are due to smoke and in summer only ¼. The other main source is combustion of gas. R. S. R.

1392. Long-Wave Part of the Visible Spectrum of the Night Sky. L. A. Sommer. *Zeits. f. Physik,* 80. 4. *pp.* 273–276, *Jan.* 23, 1933.—The author refers to a former paper [see Abstract 4982 (1932)] in which agreement was shown to exist in the wave-length structure of the night sky and auroral spectra, but considerable differences of intensity occurred. Vegard has extended the measurement of auroral wave-lengths to the red. His values are compared with the lines in the night sky spectrum. The green line 5577·350 Å is displaced to 5583·0 Å. Assuming that other lines are similarly displaced, this error arising in consequence of the small intensities, agreement in the two spectra is obtained also in the red end. R. S. R.

1393. Auroral Spectrum. J. Kaplan. *Phys. Rev.* 42. *pp.* 807–811, *Dec.* 15, 1932.—A strong uncondensed discharge is passed for

several days through a tube containing 5 to 10 mm. of nitrogen and a little oxygen. The oxygen is gradually cleaned up and the second positive bands gradually disappear from the nitrogen discharge. A discharge can be obtained of which the spectrum consists almost entirely of the first negative bands of N_2^+, and the lines of N^+ are missing. This spectrum closely resembles the auroral spectrum and it is thought that the conditions under which it is produced must resemble the conditions in the aurora very closely. The excitation of the N_2^+ bands in these experiments is thought to be due to the large concentration of metastable nitrogen molecules in the $A(^3\Sigma)$ state, and this experiment is presented as a proof of their presence in both the aurora and in nitrogen afterglows.
J. E. K.

1394. New Primary Standard Barometer. J. E. Sears, Jr., and J. S. Clark. *Roy. Soc., Proc.* 139. *pp.* 130–146, *Jan.* 2, 1933.—An account is given of a new primary standard barometer recently installed at the National Physical Laboratory to serve as a basis of reference for all measurements relating to barometric pressures. The design and general accuracy of workmanship are such that individual readings should be correct to the order of 0·001 mm. In practice it is found that the mean residual error of a single observation is of the order of 0·005 mm., this being probably attributable in the main to minute fluctuations of barometric pressure which are continually taking place, even when atmospheric conditions are reasonably steady. H. L. B.

See also Abstracts 1303, 1369, 1399, 1402, 1424.

SEISMOLOGY.

1395. Earthquakes and Variation in Latitude. H. Nagaoka. *Imp. Acad. Tokyo, Proc.* 8. *pp.* 475–477, *Dec.*, 1932. *In English.*—Continuing a previous paper [see Abstract 4846 (1932)] the change in the elements of inertia is considered during the period before great earthquakes, when, as was noticed, the course of the poleshift becomes straight. The change in these elements may take place just before a great earthquake by a simple displacement of a portion of the crust. The change in velocity of the poleshift may give a hint to prediction, though the locality cannot be stated, as there is apparently no connection between the place of disturbance and the position of the pole. If an accurate study of variation of latitude could be made, the locality might perhaps be determined. Some earthquakes arise from crustal displacement extending over a wide area. The latitude variation following the shock can only be caused by displacement of a mass equivalent to a big mountain moved through a few km. The minor earthquakes are perhaps secondary effects of great earthquakes. Observation of poleshift is made on the assumption that there is no change in the direction of the force of gravity, but of this there is no certainty. W. A. R.

1396. Characteristics of a Deep Focus Earthquake. Study of the Disturbance of February 20, 1931. F. J. Scrase. *Roy. Soc., Phil. Trans.* 231. *pp.* 207–234, *Jan.* 13, 1933.—To confirm the existence of certain characteristic features quoted in an earlier paper [see Abstract 3746 (1931)] a detailed study has been made of the seismograms and records from 90 stations of this deep focus earthquake which occurred near Vladivostock. The epicentre and time of occurrence were found, and the focus was calculated to be 360 km. below the surface near the north west end of the Japanese deep earthquake belt. Most of the records show the anticipated characteristics of well-developed, singly-reflected echoes, and the time-intervals between these and the direct waves provide reliable data for the computation of the depth of the focus when the velocities in the upper layers are known. The surface waves are feebly developed and a much greater proportion of the energy is carried by the body waves than is the case in normal shocks. The time-distance observations of the phases have been compared with the calculated curves based on the Zöppritz-Turner tables of the times of transmission of longitudinal and transverse waves ; most of the discrepancies are explained by the errors which are known to exist in these tables. When allowance is made for the abnormal depth of focus the observed times of travel of the direct waves are in much better agreement with Jeffrey's revised tables, but at distances greater than 85° Jeffrey's times for transverse waves appear to be too great. The surface waves are very difficult to recognise in most of the records, and there is no trace at all of very long Love waves. R. S. R.

1397. Interpretation of Seismic Time-Distance Curves. L. B. Slichter. *Physics*, 3. *pp.* 273–295, *Dec.*, 1932.—The theory is considered of the interpretation of seismic disturbance records in which distance travelled is correlated to time of travel, with special reference to horizontal structures associated with geophysical prospecting. The treatment is on the lines of that of Herglotz for a spherical earth, using the solutions of Abel's integral equation evolved by Wiechert, but some of Herglotz's restrictions, which are not valid for the seismic prospecting conditions, are not imposed. It is shown that multiple values, discontinuities and reversals of the curve may occur in practical problems, and cannot be ignored, and in seismic prospecting triple valued time-distance curves must be anticipated. The occurrence of such curves, including a reverse segment between two forward segments, in the simple case of a contact between two uniform horizontal beds of different velocities of propagation, is stressed, and the error involved in the usual treatment which ignores this reverse segment is computed. Special consideration is given to the discontinuous curves associated with the presence of a lower, slower speed bed. This case offers experimental difficulties in the complete identification of the curve. E. L. J.

1398. New Vertical Seismograph. H. Benioff. *Seismological Soc. of America, Bull.* 22. *pp.* 155–169, *June*, 1932.—The essential parts are the bob, which is a cylindrical mass of weight 100 kg., suspended with axis vertical by a helical spring such that the period of vibration is about 0·5 sec., and compelled to vibrate strictly vertically, and below it a magnet the armature of which is attached rigidly to the bob and separated by an air gap from the magnet. The vertical vibrations of the bob alter the width of this gap, and consequently the strength of the magnetic flux, the variations of which are measured electrically. Full details and examples of the records obtained are given. C. A. S.

See also Abstracts 1384, 1385.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

1399. Aitken Pocket Nuclei-Counter. G. R. Wait. *Gerlands Beitr. z. Geophys.* 37. 4. *pp.* 429–439, 1932. *In English.*—It is experimentally shown that nuclei falling in consequence of expansions subsequent to the first are not due to previously fallen nuclei returning after evaporation inside the pump-chamber, and therefore that all should be counted; also that the error made in assuming that the same percentage of nuclei falls inside the pump-chamber as inside the receiver is negligible. C. A. S.

1400. Measurements of the Ionic Spectrum in Leiden. J. Booij and A. J. S. van Leeuwen, Jr. *Gerlands Beitr. z. Geophys.* 37. 4. *pp.* 361–366, 1932.—The results of measurements of ions are given for Leiden, and these show that in one case groups predominate with the mobility (k) 2 to 3 $\times 10^{-4}$ and 1 $\times 10^{-4}$ and in the other for 1 $\times 10^{-4}$ to 0·5 $\times 10^{-4}$. The ions of mean size predominate, but considerable numbers of large ions occur. The ionic spectrum is not continuous and very few small mean ions are present. The author considers that still larger ions may occur even up to visible dimension, but they may not carry an elementary charge. The results are compared with Israel's discontinuous spectrum at Frankfort and Bad Gastein and the author's continuous spectrum at Innsbruck. The differences are ascribed to foreign matter in the atmosphere in these places serving as nuclei. [See Abstract 985 (1933).] R. S. R.

1401. Comparison of Methods for Counting the Ions in the Atmosphere. H. T. Graziadei. *Phys. Zeits.* 34. *pp.* 82–88, *Jan.* 15, 1933.—Using the special " guard-ring " precaution suggested initially by W. F. G. Swann, the method of maintaining the outer electrode at a high potential, and therefore driving the ions on to the inner electrode (which is initially insulated and uncharged), is found to yield results comparable in value with those obtained by the discharge method (outer cylinder earthed: inner electrode charged to a high potential and then insulated) if the same length of inner electrode is used in both cases. The use of the relatively long electrode, however, essential to Swann's method, gives results which are about 30% greater than the most reliable and accepted results obtainable by the other method. The existence of periodic fluctuations in the ion content of the atmosphere, found by P. A. Sheppard, is not confirmed. F. C. C.

1402. Variations in Potential Gradient Caused by Some Meteorological Phenomena. J. M. Sil. *Roy. Meteorolog. Soc., J.* 59. *pp.* 23–34, *Jan.*, 1933.—The different meteorological phenomena which the author considers to have an effect on the potential gradient are strong insolation, strong winds on a dry hot day, sea breeze, dust storms, haze, fog and inversion, cumulus clouds forming overhead. These are all considered in detail; photographic records of potential gradient near the ground obtained with a Cambridge electrograph, together with wind, temperature, and humidity records, are reproduced illustrative of the behaviour of the potential gradient under the various conditions referred to above. The paper concludes with a discussion on the subject by members of the Society. A. E. M. G.

1403. Relation between Diurnal Variations of Earth Current and Terrestrial Magnetic Field. D. Stenquist. *Comptes Rendus*, 196. *pp.* 205–207, *Jan.* 16, 1933.—Variations in the E–W (ΔE) and N–S (ΔN) components of the earth current as recorded at Sodankyla, Lund, Paris, Tortosa, and Batavia, and also $\tan^{-1}\Delta N/\Delta E$ are plotted against time of day, and the latter compared with the similar curve showing variations (ΔZ) in the earth's magnetic field on calm days. A north pole of diurnal variation is indicated between the latitudes of Paris and Tortosa, and close connection between the earth current and its magnetic field; but although the direction is correct the sense is the opposite of that required by Ampère's rule, so that the earth current tends to diminish the magnetism which follows the direction of the Heaviside current except during magnetic storms when the earth current predominates. C. A. S.

1404. Earth's Magnetisation in Ancient Times. J. Koenigsberger. *Gerland's Beitr. z. Geophys.* 38. 1. *pp.* 47–52, 1933.—The author reviews the value of observations made upon the direction of magnetisation in baked clay vessels preserved from ancient times, and in erupted rocks, upon the question of the variation of the direction of the earth's magnetisation throughout the ages. His tests have confirmed the tenacity with which burnt clay pots and tiles retain their original magnetisation in spite of changes in temperature and shocks. Owing to the changes in direction of magnetisation of erupted rocks on account of their flow whilst plastic, conclusions can only be drawn from their present magnetisation if a large number of samples are taken from different points of the mass. E. L. J.

1405. Terrestrial Magnetic Variations of Short Duration. A. H. R. Goldie. *Roy. Meteorolog. Soc., J.* 59. *pp.* 3–15, *Jan.*, 1933.—The main facts are first reviewed, mention being made of changes in magnetic force and the effect of latitude, time of day and magnetic character on these variations. The main features of the diurnal variation on magnetically disturbed and quiet days and non-cyclic effects are discussed. To interpret the facts the various theories relating to air and electric currents in the upper atmosphere, including those of Chapman, Störmer, Appleton, Gunn and Hulburt, are considered and conclusions are drawn regarding their relative merits. R. S. R.

1406. Audibility of the Aurora and its Appearance at Low Atmospheric Levels. C. S. Beals. *Roy. Meteorolog. Soc., J.* 59. *pp.* 71–78, *Jan.*, 1933.—The author reviews former reports of these phenomena and analyses reports he has received from reliable observers in Canada. Two types of sounds are distinguished corresponding to swishing and crackling, and the infrequency of the reports is attributed to the phenomenon being rare and having local variations of audibility, while the acuteness of hearing varies among observers. The sounds are attributed to a form of brush discharge. The existence of low level auroræ is confirmed by trained scientific observers who have seen them against a recognised background. R. S. R.

See also Abstract 1387.

RADIOACTIVITY.

1407. Radioactive Families. Edna R. Bishop. *Phys. Rev.* 43. *pp.* 38–42, *Jan.* 1, 1933.—Having investigated the isotopes of the radioactive bodies by the magneto-optical method, the author has drawn up a scheme of radioactive disintegrations which would produce the required number of isotopes. The scheme includes the elements virginium and alabamine in the transformation products, but it excludes the C'' bodies. Six isotopes each of protoactinium, actinium, and alabamine, four of radon, and eight of polonium are included in the plan. J. E. R. C.

1408. Isotopes of Uranium, Thorium and Lead, and their Geological Significance. C. S. Piggot. *Phys. Rev.* 43. *pp.* 51–59, *Jan.* 1, 1933.—With a view to the calculation of geologic age a determination of the isotopes of the elements involved in the radioactive disintegrations (At. Nos. 81–92) was made by the magneto-optic method of Allison. There appear to be four radioactive series beginning with eight isotopes of U (two to each) and ending with sixteen isotopes of Pb (four to each). The relations of the constituent isotopes of U to those of Pb in a mineral are complex and vary from mineral to mineral. Ordinary Pb and radio-derived Pb have different isotopic compositions though both apparently originate from the same ultimate source. The isotopic composition of Pb changes with age. The most accurate age determination would be obtained by restricting calculation to the U^{238} and Pb^{206} isotopes respectively.

J. J. S.

1409. Polonium Acetylacetonate. Servigne. *Comptes Rendus,* 196. *pp.* 264–266, *Jan.* 23, 1933.—Polonium hydroxide dissolves to the extent of more than 90% in acetylacetone, the evaporated product is soluble in chloroform, benzene, ethyl alcohol, acetone, and acetylacetone, and in chloroform at least is not ionised. Fractional crystallisation of the mixed acetylacetonates of thorium, aluminium, and polonium indicates concentration of polonium with thorium, and therefore that polonium is quadrivalent in this compound. C. A. S.

1410. Effect of Gaseous Impurities on the Radiochemical Combination of Carbon Monoxide and Oxygen. C. Rosenblum. *Am. Chem. Soc., J.* 55. *pp.* 220–223, *Jan.*, 1933.—The effect of the vapour of water, formic acid and nitrogen on the combination of carbon monoxide and oxygen in the presence of radon has been studied [see Abstract 3973 (1932)]. While water had a small retarding effect, formic acid did not directly affect the velocity of the main reaction but tended merely to mask its course in the early stages by undergoing decomposition, and nitrogen had an extreme accelerating influence on the oxidation which could be explained by an increase in the catalytic efficiency of carbon dioxide from 14·5 to 30% in addition to the 100% efficiency of nitrogen. H. H. Ho.

1411. Apparatus for the Purification of Radon. R. Livingston. *Rev. Sci. Instruments,* 4. *pp.* 15–17, *Jan.*, 1933.—The paper describes an apparatus designed to eliminate the necessity of replacing the chemical purifying trains after each run and of evacuating and " baking out " the reagents before each run. The efficiency of the apparatus is discussed and minor modifications that may make the apparatus more useful for certain purposes are suggested. W. E. P.

1412. Radioactive Content of Rocks by the Geiger-Müller Counter. W. Vogt. *Phys. Zeits.* 34. *pp.* 79–82, *Jan.* 15, 1933.—The radioactive content of rocks is determined with an experimental arrangement based on the Geiger-Müller counter. The average statistical error is a series of readings over a period of 6 hours, limits the sensitivity to the detection of $2{\cdot}5 \times 10^{-13}$ of Ra in 1 gm. of rock; this amount is also the radioactive content of the average rock sample. The method is superior to the emanation method in simplicity and rapidity. F. C. C.

1413. Efficiency of Carbon Dioxide as a Radiochemical Catalyst. C. Rosenblum. *J. Phys. Chem.* 37. *pp.* 53–58, *Jan.*, 1933.—Carbon dioxide is an inefficient catalyst in radiochemical reactions such as polymerisation of acetylene, synthesis of water and oxidation of carbon monoxide. A. S. C. L.

1414. Energy Distribution of β-Rays from Atoms of Known Age. B. W. Sargent. *Roy. Soc. Canada, Trans.* 26. *pp.* 205–216, *May*, 1932.—The paper describes experiments to investigate whether the energy distribution of β-rays depends on the age of the emitting atoms. In order to obtain a supply of atoms of known age, thorium C″ atoms were collected by recoil on a moving tape. It was found that the absorption in paper of the β-rays from thorium C″ was not obviously dependent on the age of the emitting atoms, and it is concluded that within the limits of experimental error atoms of thorium C″ of different ages emit β-particles having the same energy distribution. W. E. P.

1415. Scattering of β-Rays. Part I. B. W. Sargent and A. J. O'Leary. *Roy. Soc. Canada, Trans.* 26. *pp.* 217–232, *May*, 1932.—A description is given of some experiments carried out in 1927–28 on the scattering of β-rays from radium E by gases and vapours. Relative values of the scattering from a definite volume at average angles of 60° and 90° were obtained. For gaseous compounds of H, CN and O the intensities of the scattered rays are proportional to their molecular scattering numbers, in accordance with Rutherford's theory. The scattering from gaseous compounds of S, Cl, Br and I, relative to that in CO_2, is in some cases greater than that given by Rutherford's theory. Absorption experiments showed that the scattered β-rays are more penetrating the higher the atomic number of the scattering atoms. The most satisfactory explanation of this is that a β-ray, on being scattered by a nucleus, suffers a considerable loss of energy whose magnitude increases with decreasing atomic number. W. E. P.

1416. Magnetic Spectrum of β-rays from ThB + C + C′ + C″ and from AcB + C + C′ + C″. S. Y. Sze. *Ann. de Physique*, 19. *pp.* 59–83, *Jan.*, 1933.—Using the method of magnetic focussing, the energies of the β-rays emitted by the active deposits of Th and of Ac are investigated. Lines as fine as 0·005 cm. are obtained; some of these, originally thought to be simple, are shown to be multiplets. The lines of ThB at Hρ 1760 and 1119 are shown to be doublets and from their existence it is concluded that, contrary to previous ideas, the probability of internal conversion of the γ-rays of energies 100 and 240 *e*kV, is not zero. From the extreme fineness (about 0·003 cm.) of the group of β-rays from ThB at Hρ 1398, it is concluded that this group is homogeneous to about 90 *e*V and, further, that the γ-ray at 240·7 *e*kV is homogeneous to about 140 *e*V. It is found that ThB emits several β-rays having energies identical with those of certain β-rays from RaB. The existence of several groups of β-rays of feeble intensity in the spectrum of ThC + C′ + C″ is indicated, particularly in the region of Hρ 6000. From these measurements it is concluded that in the transformation ThC → ThC′, γ-rays are emitted with energies 40·6, 289·3, 303·0 and 581·2 *e*kV. These values are equal to the energy differences between the groups of α-rays emitted by ThC. It is found that in the transformation AcC → AcC″, a γ-ray is emitted, the energy of which is equal to that of the difference of the energies of the two groups of α-rays from AcC. These facts confirm the definite existence of a connection between the γ-rays and the fine structure of the α-rays. F. C. C.

1417. Upper Limit of Energy in the β-Ray Spectrum of Actinium B. B. W. Sargent. *Cambridge Phil. Soc., Proc.* 29. *pp.* 156–160, *Jan.* 31, 1933.—Using a thin-walled electroscope, absorption curves in paper and aluminium are obtained for the β-rays of actinium (B + C) and actinium C″. From these curves the range of the β-rays from actinium B is found to be 0·08 ± 0·02 gm./cm^2. The energy required for this range is 300,000 ± 50,000 V, which must be the end-point of the continuous spectrum. On account of the overlapping of the β-ray spectra of actinium B and actinium C″, the range method can never yield an accurate value of the end-point of the former. Magnetic analysis is suggested, but the weakness and rapid decay of sources are formidable difficulties. F. C. C.

1418. γ-Rays from ThC and ThC″ and the Fine Structure of the α-Rays. Lise Meitner and K. Philipp. *Zeits. f. Physik*, 80. 5–6. *pp.* 277–284, *Jan.* 31, 1933.—A repetition of the authors' experiments using stronger ThC″ sources confirms the previous results, in which the γ-ray lines of 40·8 and 279 kV energy are attributed to the transformation ThC″ → ThPb. However, from recent measurements of Rosenblum on the fine structure of the α-rays from ThC, it appears that on the usual Gamow theory, the associated γ-ray has an energy of 292 kV and not 279 kV. Also, the lines, according to Gamow's theory, are not associated with the transformation of ThC″. The line at 40·8 kV is a doublet, the weaker component of which corresponds to the transformation ThC″ → ThPb, while the stronger corresponds to the transformation ThC → ThC″. 21 groups of β-rays from the ThC″ are found, 4 of which had not previously been noted. F. C. C.

1419. Disintegration of Light Elements by Fast Protons. J. D. Cockcroft and E. T. S. Walton. *Nature*, 131. *p.* 23, *Jan.* 7, 1933.—The authors have now reduced the absorption in the path of the disintegration particles produced in their apparatus by the bombardment of certain elements with fast protons. The radiation from lithium now appears to consist of two groups of α particles of range 8·4 cm. and 2 cm. respectively and it is suggested that this difference of energies should cause some γ-radiation. The radiation from boron appears to consist of α-particles of range about 3 cm. The yield appears to be of the order of one particle per 2×10^6 incident protons possessing 500 kV of energy. It is possible that there is a minor group of α-particles with a range of about 5 cm. J. E. R. C.

1420. Neutron and Neuton. W. D. Harkins. *Nature*, 131. *p*. 23, *Jan*. 7, 1933.—The author proposes that, as the neutron may be considered to constitute a new element, this element might be called "neuton." It is shown that the number of neutrons in a nucleus equals the sum of the isotopic and atomic numbers of the element. J. E. R. C.

1421. Mobilities of Molecular Aggregates in Gases Containing Radon. E. L. Harrington and E. O. Braaten. *Roy. Soc. Canada, Trans.* 26. *pp*. 177–186, *May*, 1932.—The mobilities have been determined (1) directly by means of the ultramicroscope, and (2) by Erikson's method, a slow stream of radon-containing air being passed between plates at 1500 V. Method (1) gives the same mobility, $1 - 6 \times 10^{-4}$ cm./sec. per volt/cm. and decreasing with the age of the cell, for all aggregates, a fact best explained by the assumption that the particles are carried along by a sort of ionic wind. Method (2) gives a much larger deposit on the kathode, indicates that the aggregates may carry either a negative or positive charge, and implies mobilities of $1{\cdot}6 \times 10^{-3}$ to $1{\cdot}4 \times 10^{-4}$ cm./sec. per volt/cm. It is concluded that the mobilities vary widely. [see also Abstract 2327 (1931).] C. A. S.

1422. Attempt to Demonstrate the Presence of Neutrons in the Atmosphere. W. Meissner and K. Steiner. *Zeits. f. Physik*, 80. 1–2. *pp*. 1–3, *Jan*. 6, 1933. *From the Reichsanstalt*.—If neutrons are present in the atmosphere, they should be concentrated in the helium gas remaining from a final liquefaction of helium fractionated from the air. In the apparatus employed a partial pressure of "neutron gas" corresponding to 1 part in 10^5 could have been but was not observed. In the fractionation process, the content had been enriched 6×10^5 times. The upper limit for the neutron content in air is thus 1 part in $1{\cdot}6 \times 10^{11}$. This is of the same order as that predicted by Swinne [see Abstract 3800 (1932).] C. B. A.

1423. Experimental Proofs of the Existence of the Neutron. Irène Curie and F. Joliot. *J. de Physique et le Radium*, 4. *pp*. 21–33, *Jan*., 1933.—The action of α-radiation from polonium on beryllium, boron, or lithium was found to give rise to a type of radiation of nuclear origin, which was investigated by the Wilson cloud track method, by the ionisation produced in air or helium, and by absorption. The new radiation was shown to consist of γ-rays and a radiation of high energy having analogous penetrating power in lead, but of lesser penetrating power in paraffin, and thus not of electronic nature as was previously supposed, but considered to be neutrons or particles of zero charge and mass approximately 1. A mechanism of neutron emission and a survey of the energy and collision properties of neutrons are discussed. N. M. B.

1424. Atmospheric Radioactivity. G. Aliverti. *N. Cimento*, 9. *pp*. 313–327, *Dec*., 1932.—Discusses the series of 80 determinations of atmospheric radioactivity with the method of the electric effluvium and disactivation. The method is very useful in giving the active deposits from the air at any instant quantitatively. The second and third decades of March show the greatest atmospheric activity. During the prevalence of a N.N.W. wind ("föhn") in Turin the active deposits almost completely disappear. [See Abstracts 889 (1932) and 558 (1933).] E. E. F. d'A.

See also Abstracts 1253, 1254, 1255, 1256.

RADIATION.

ABSORPTION AND TRANSMISSION.

1425. Optical Constants of Transparent Silver. H. Murmann. *Zeits. f. Physik*, 80. 3–4. *pp.* 161–177, *Jan.* 23, 1933.—A method is described of determining the optical parameters of very thin absorbing layers of known thickness, deposited on a transparent plate, from the intensity of the reflected and transmitted light. The method is applied to silver layers produced by sublimation in a high vacuum. The author finds similar anomalies to those already known to exist in the case of sputtered films and those produced by chemical deposition. The dependence of the optical constants on the thickness of the films is discussed. A comparison of the result with that obtained by Pogány by another method indicates that the density of silver of thickness 15mμ does not differ from that of pure silver. H. L. B.

See also Abstracts 1388, 1427, 1653.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

1426. Relationship between Anisotropy of the Optical Polarisability and the Geometrical Structure of a Molecule. H. A. Stuart and H. Volkmann. *Zeits. f. Physik*, 80. 1–2. *pp.* 107–124, *Jan.* 6, 1933.—The Kerr constants of the vapours of a series of benzene derivatives of known structure have been measured, and from the results the corresponding optical polarisation ellipsoids (the anisotropies of the optical polarisabilities) have been calculated. A clear definition of this characteristic constant of a molecule is given. A detailed comparison of the geometrical structure with the optical polarisation ellipsoid shows that simple and quantitative relationships exist between the two, and that these are the ones required on the Silberstein theory of atomic dipoles. This theory can thus be employed with safety as a working hypothesis in more difficult cases in the determination of molecular structure. It is also shown that in suitable cases the polarisation ellipsoid of a molecule can be theoretically predicted. C. B. A.

1427. Rotatory Magnetic Dispersion of a Diamagnetic Coloured Compound. Thiobenzophenone. A. Cotton and M. Schérer. *Comptes Rendus*, 195. *pp.* 1342–1345, *Dec.* 27, 1932.—Anomalies have been observed on each side of the single absorption band. The derivative $d\rho/d\lambda$ has opposite signs on either side, positive on the short-wave side. [See also Abstracts 561 and 562 (1933).] J. E.

1428. Magnetic Rotatory Power of Chlorine and of Gaseous Hydrogen Chloride. R. de Mallemann and P. Gabiano. *Comptes Rendus*, 196. *p.* 106, *Jan.* 9, 1933.—The atomic rotation of chlorine is given as $10 \cdot 4 \times 10^{-5}$ (radians) and that of hydrogen chloride as $13 \cdot 1 \times 10^{-5}$ (radians). The sum of the atomic rotations of chlorine and hydrogen is $12 \cdot 4 \times 10^{-5}$, so that the vicinity of an atom of hydrogen increases the atomic rotation of chlorine as already observed in the cases of methyl, ethyl and propyl chlorides. H. H. Ho.

1429. New Photomagnetic Effect. D. M. Bose and P. K. Raha. *Zeits. f. Physik,* 80. 5–6. *pp.* 361–375, *Jan.* 31, 1933.—By a sensitive torsion balance method it is shown that solutions containing Cr^{+++}, Fe^{++}, Co^{++}, Ni^{++}, Cu^{++}, etc., increase in magnetic susceptibility when they are irradiated with light of wave-lengths which they can absorb, while solutions containing Ti^{+++} and Ce^{+++} show no alteration. It is assumed that the paramagnetic ions are present as hydrated complexes, and that the orbital moments of these ions are partly fixed by interaction with the associated water molecules (*l*-coupling). By the absorption of light the *l*-coupling is temporarily weakened, and the observed increase in magnetic susceptibility is partly derived from orbital moments as well as from the spin moments, both effects now contributing to the total magnetic moment of the ion. [See also following abstract.] C. B. A.

1430. Nature of the Absorption Centres in Crystals and Solutions Containing Paramagnetic Ions. Mechanism of the Absorption. D. M. Bose and S. Datta. *Zeits. f. Physik,* 80. 5–6. *pp.* 376–394, *Jan.* 31, 1933.—In crystals of paramagnetic salts containing water of crystallisation and in their aqueous solutions, hydrated complexes are the source both of light absorption and of the paramagnetic effects. In addition to the electrostatic forces between the ion and the associated water dipoles, there exists an *l*-coupling [see preceding Abstract]. This produces a discrepancy between the observed magnetic moment of the ion and that calculated from the Hund formula, and also a displacement in the position of the absorption band compared with that in the isolated ion. In order to absorb light, the ion must be freed from the *l*-coupling, and the increased energy required determines the change in frequency of the maximum absorption, and the change in magnetic moment. It is also shown that a decrease in temperature should produce a shift of absorption towards the blue and a decrease in magnetic moment. Examples are given.

C. B. A.

See also Abstracts 1253, 1254, 1255, 1256.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

1431. Monochromatic Excitation of Iodine Fluorescence. I. I. Agarbiceanu. *Comptes Rendus,* 196. *pp.* 166–168, *Jan.* 16, 1933.—The mechanism of excitation of the fluorescence of iodine has been followed by the help of an echelon spectroscope for the rays 5461, 5769 and 5790 of Hg. On the continuous background of 5461 the Wood absorption rays 2, 3, 4, 5, have been obtained. The origin of these is discussed. Nine absorption lines were obtained in the region of 5769 and 3 in the region 5790. J. E.

1432. Fluorescence of Cd Vapour. (Miss) E. Kalinowska. *Comptes Rendus,* 196. *pp.* 168–170, *Jan.* 16, 1933.—The work of Kapuściński [see Abstract 1741 (1927] and that of Jabloński [see Abstract 918 (1928)] have shown that when Cd vapour is illuminated with light in the region 1900–2100, corresponding to the molecular absorption the resulting fluorescence shows the atomic rays 4678, 4800 and 5086, _ 2^3S _ 2^3P. This means a very high excitation energy, and in order to find whether the initial state 2^3S is reached in one or two acts of absorption, experiments were carried out with varying intensities of excitation. If the excitation is in one stage the intensity of the excited light should be proportional to that of the exciting light. The results indicate that this is so. The explanation suggested is that there exist molecules with feeble linkages, which, when excited, give up their energy to free atoms, formed possibly by dissociation of these molecules at the moment of excitation by collisions. J. E.

1433. Nature of Active Nitrogen. J. Okubo and H. Hamada. *Phys. Rev.*, **42.** *pp.* 795–799, *Dec.* 15, 1932.—The following assumptions account for all the observed results as reasonable consequences of the Franck Condon principle, without assuming the existence of metastable atoms as do Cario and Franck. In the vibrational states with $v'' = \sim 8$ in the metastable $A^3\Sigma$ state and also in those with $v = \sim 6$ in the upper $B^3\Pi$ state the near-nuclear turning points of the vibration have the same or nearly equal nuclear separations as those in the equilibrium position of nuclei in the normal molecular state. With the exception of the neutral unexcited molecules and atoms in the active nitrogen the metastable $A^3\Sigma$ molecules in the vibrational state with $v'' = 7$ or 8 are most concentrated. AUTHORS.

1434. Nature of the Dark Modification of Active Nitrogen. J. Okubo and H. Hamada. *Phil. Mag.*, **15.** *pp.* 103–113, *Jan.*, 1933.—It has been reported by Cario and Kaplan that the visible afterglow of active nitrogen disappears on heating [see Abstract 1649 (1929)]. They suppose that the visible afterglow is due to collisions of the second kind between metastable molecules and metastable atoms and that by heating or passing a weak electric discharge through it the metastable molecules disappear. Willey [see Abstract 2707 (1928)] found that active nitrogen passes into the glowless form on passing through it a weak discharge. The object of this work was to find out whether the glowless state is really different from the afterglowing state and whether the glowless state observed by Cario and Kaplan is the same as that obtained by Willey. Experiments have been carried out on the catalytic action of metal and glass surfaces on active nitrogen, and on the afterglow at high temperatures. The dark modification of Cario and Kaplan was not discovered, but it is found that active nitrogen possesses the same energy in a strongly heated state, weakly glowing or nearly dark according to purity, as in the ordinary glowing state. Further experiments with weak electric discharges in active nitrogen shows that activity is lost simultaneously with the quenching of the glow, but a glowless state was not confirmed. J. E.

1435. Spectrographic Method of Luminescence Excitation. G. Heyne and M. Pirani. *Zeits. f. techn. Physik*, **14.** 1. *pp.* 31–33, 1933.—The method consists in covering one side of a photographic plate, or one side of a glass plate in front of it, with the luminescent preparation in a thin transparent layer. A quartz spectrograph is used, and the excitation light is from the condensed spark between a carbon electrode soaked in tungstic acid or uranyl chloride, or between Cd–Ag, Cd–Cd or Cd–Zn electrodes. Photographs are given of the excitation of ZnS and calcium tungstate. J. E.

See also Abstract 1393.

INTERFERENCE. DIFFRACTION AND SCATTERING.

1436. Triple Interferometer for Distinguishing Flexural and Longitudinal Vibrations in Quartz. H. Osterberg, *J.O.S.A.* **23.** *pp.* 30–34, *Jan.*, 1933.—A triple interferometer arrangement for determining the relative motion of opposing areas on the front and back surfaces of any vibrating plate is described and illustrated. The manner in which this interferometer is used to distinguish between flexural and longitudinal modes in quartz plates is also discussed and illustrated. These illustrations are selected to demonstrate several very interesting characteristics of an oscillating quartz plate. In the case of a quartz cube operated as an X-cut the influence of lateral vibrations is seen to affect seriously the computed frequency of the fundamental longitudinal waves propagated along X. A simple interferometer employed in the study of quartz plates is described, together with a strip method of excitation used in conjunction with this interferometer. AUTHOR.

1437. Interferential Comparison of Radiations Emitted by a New Cadmium Lamp and the Michelson Lamp. J. E. Sears, Jr., and H. Barrell. *Roy. Soc., Proc.* 139. *pp.* 202–218, *Jan.* 2, 1933.—The possibility was investigated of replacing the Michelson lamp by the recently developed Osram lamp as a source of the standard red radiation of cadmium for measurements of length. The Osram lamp is a discharge tube of the hot-kathode type and provides a large and brilliant source of monochromatic radiations. Comparisons were made, by means of a Fabry-Perot interferometer, of the wave-lengths of the red radiation emitted by the two sources at a series of path differences. At the same time, measurements were made of the wave-lengths and fine structure of the green and two blue radiations emitted by the two sources. It is found that the wave-length of the red line produced from both sources is the same to an accuracy of at least 1 part in 16,000,000. Consideration of the fine structure of the other radiations, however, leads to the restriction that the Osram lamp is a satisfactory substitute for the Michelson lamp only when excited by a current of about 1 ampere or less. For exciting currents of 2 amperes the principal components of three of the radiations show evidences of self-reversal. H. B.

1438. Photographic Method of Deriving the Optical Constants of Metals. S. E. Williams. *Phys. Soc., Proc.* 45. *pp.* 49–66, *Jan.* 1, 1933.—A grating consisting of alternate strips of glass and metal of known dimensions gives diffraction spectra whose relative intensities depend on the optical properties of the component parts. An expression has been found for the relative intensities of the central reflected image and the first principal diffracted image in terms of the reflection co-efficients for the metal and glass and the phase-change on reflection from the metal surface. By means of a photometric method, which is described, the intensity ratio has been measured for two or more gratings of different proportions cut on one mirror, enabling the deduction of the reflection co-efficients and the change of phase is to be made. This is done for light plane-polarised both in and perpendicularly to the plane of incidence, and the approximate Drude formulæ are used to calculate the optical constants. It is possible to make simultaneous measurements at several wave-lengths if the grating is illuminated with light from a source having a suitable line spectrum. With gratings cut from sputtered platinum films, the means of six sets of results for the yellow doublet of the mercury arc were $k = 1\cdot40$ and $n = 1\cdot67$. An investigation is made of the most favourable conditions, and the possibilities and limitations of the method are discussed. AUTHOR.

1439. Multiplex Step-like Gratings. E. Lau. *Zeits. f. Physik,* 80. 1–2. *pp.* 100–104, *Jan.* 6, 1933.—The construction of a multiplex step-like grating from two different thicknesses of material bound alternately to each other is discussed. Such gratings can have great resolving power. W. R. A.

1440. Theory of Multiplex Step-like Gratings. P. Görlich. *Zeits. f. Physik,* 80. 1–2. *pp.* 105–106, *Jan.* 6, 1933.—A simple method of calculating the dispersion and resolving power of multiplex step-like gratings is given. W. R. A.

1441. Simple Method of Producing and Projecting Mercury Ripples. A. R. Harmon and J. B. Brinsmade. *Rev. Sci. Instruments,* 3. *pp.* 803–809, *Dec.,* 1932.—Ripples are produced by alternating electrostatic forces produced by means of suitably-shaped pieces of metal supported above the mercury surface and connected to a h.t. transformer giving 2000 V at 60 ∼. The frequency of the ripples is twice that of the alternating current supply. The ripple pattern is projected on a screen or photographic plate by allowing light from an a.c. 60-cycle carbon arc to fall on the centre of the horizontal mercury surface at 45°. A method of showing the ripples in slow motion is also discussed. Photographs showing interference between two point sources and between a line and a point source are reproduced. W. R. A.

See also Abstracts 1356, 1479, 1482, 1521, 1537, 1657.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

1442. Photodissociation of Hydrogen Peroxide. G. v. Elbe. *Am. Chem. Soc., J.* 55. *pp.* 62–69, *Jan.,* 1933.—Mixtures of hydrogen peroxide vapour and hydrogen or carbon monoxide have been exposed to the light of a zinc spark, and the kinetics of the reaction between the assumed product of dissociation, hydroxyl, and hydrogen or carbon monoxide studied at different partial pressures and temperatures. The results do not sustain the reaction scheme of Frankenburger and Klinkhardt, involving the recombination of two hydroxyls to H_2O_2. There appear to be no facts available which disturb the Bonhoeffer-Haber mechanism for the formation of water from hydrogen and oxygen. H. H. Ho.

1443. Photo-Oxidation of Gaseous Hydrogen Iodide. J. R. Bates and G. I. Lavin. *Am. Chem. Soc., J.* 55. *pp.* 81–89, *Jan.,* 1933.—For some time it was thought that the quasi molecules, such as HO_2, assumed to be formed initially in the reaction between hydrogen atoms and oxygen molecules, could exist only for 10^{-13} to 10^{-14} second. It has, however, been suggested by Kassel (*ibid.,* 53. p. 2143, 1931) and demonstrated experimentally by Pease (*ibid.,* 54. p. 1876, 1932) in the hydrogenation of ethylene that these molecules may have greater lifetimes, especially where the molecule is polyatomic. Application of simple reaction theory to the experimental results of a study of the kinetics of the photo-oxidation of gaseous hydrogen iodide leads to the conclusion that the quasi molecule HO_2 can have a life of 10^{-8} to 10^{-9} sec., which is thus several orders of magnitude greater than that usually ascribed to such complexes. T. H. P.

1444. Temperature Coefficient of the Photosensitised Hydrogen-Oxygen Reaction. H. S. Taylor and D. J. Salley. *Am. Chem. Soc., J.* 55. *pp.* 96–109, *Jan.,* 1933.—The temperature coefficient of the

ammonia-sensitised hydrogen-oxygen reaction is anti-Arrhenius at temperatures above 300°C., whilst that of the mercury-sensitised reaction is anti-Arrhenius only above 490°, so that a marked increase in chain-length occurs at a much lower temperature in the former case. The temperature coefficients of the mercury-sensitised and the direct photochemical reactions of hydrogen and oxygen are comparable over the whole temperature range, and it is suggested that the chain mechanism of the reaction is the same whether initiated by atomic oxygen or atomic hydrogen. The rate of reaction in mixtures of hydrogen and oxygen sensitised by ammonia is markedly dependent on the concentration of the ammonia. At low concentrations, a chain-propagating influence of ammonia is effective, whereas at high concentrations a chain-breaking effect of the ammonia becomes predominant. Sensitisation of hydrogen-oxygen mixtures by ammonia is not simply a case of reaction by hydrogen atoms; NH_2 radicals and intermediate oxidation products of these may help to propagate the chains. The divergence of the ammonia-sensitised from the mercury-sensitised reaction of hydrogen and oxygen is ascribed to the powerful influence of ammonia in the course of the reaction.
T. H. P.

1445. Reaction of Hydrogen Atoms with Oxygen and the Hydrogen-Chlorine Reaction. J. R. Bates. *Nat. Acad. Sci., Proc.* 19. *pp.* 81–85, *Jan.*, 1933.—Recent work on the mechanism of the hydrogen-chlorine photo-reaction is discussed, particularly the influence of water vapour on the reaction. T. H. P.

1446. Combination of Hydrogen and Oxygen Photosensitised by Nitrogen Peroxide. R. G. W. Norrish and J. G. A. Griffiths. *Roy. Soc., Proc.* 139. *pp.* 147–162, *Jan.* 2, 1933.—At 300–500°C. the general results of Thompson and Hinshelwood are confirmed [see Abstract 3434 (1929)]. The sharp limits of pressure defining the explosive reaction are found to bound a region of strong catalysis exhibiting measurable reaction velocity; inflammation was obtained only at 495°. Under such conditions the reaction is photochemically sensitive, exposure of the reaction vessel to the rays of a mercury vapour lamp resulting in magnification of the thermal effect, fourfold at 300° and twofold at 360°C.; at 450° the thermal velocity became so great that the photochemical effect was not detectable in comparison therewith. From the fact that the photochemical catalysis is subject to the same wave-length threshold as the simple photochemical decomposition of nitrogen-peroxide, it is concluded that oxygen atoms form the starting-point of the reaction chains for the photosensitised reaction. Evidence that in the thermal catalysis, the function of the nitrogen peroxide is to provide atoms of oxygen to start the reaction is furnished by the observation that the pressure-limits of the peroxide are the same for the photochemical effect as for the thermal catalysis. On the basis of the Haber theory of the hydrogen-oxygen explosion, a kinetic mechanism is developed which involves the starting of reaction chains on atoms of oxygen and their termination either at the surface or on molecules of nitrogen peroxide. T. H. P.

1447. Photochemical Kinetics of the Iodine-Oxalate Reaction. Part I. E. Abel, H. Schmid and K. Retter. *Zeits. f. phys. Chem.* 163. *Abt. A.* 1. *pp.* 53–66, *Dec.*, 1932.—The photochemical kinetics of the reaction between iodine and oxalic acid has been investigated at 25° in unfiltered and filtered mercury light (λ = 3660 and 4050Å), with practically total absorption of the incident radiation and constant intensity of radiation, between wide limits of concentration, and with complete homogenisation of the photolyte. Under the conditions employed, with constant I' concentration, independence of the velocity of reaction on the iodine-content is realised. The velocity is proportional to the concentration of the oxalate and to that of the binoxalate, the distribution between these two being about 1 : 0·03. No evidence indicating a reaction between iodine and oxalic acid is obtainable. For values of the iodine concentration $[I']$ below about 0·001, the inverse proportionality between this concentration and velocity is no longer fulfilled, the velocity increasing more slowly than the concentration diminishes; this behaviour is in agreement with the division of the absorption of the radiation between I_2 and I'_3. T. H. P.

1448. Photochemical Oxidation of Phosgene. G. K. Rollefson and C. W. Montgomery. *Am. Chem. Soc., J.* 55. *pp.* 142–147, *Jan.*, 1933.—The photochemical oxidation of phosgene was studied in quartz vessels. The source of illumination was the full light of the quartz mercury arc. The course of the reaction was followed by the changes in pressure, with sulphuric acid or mercury in the gauges. The rate of the reaction was found to be proportional to the first power of the incident intensity. A mechanism is suggested for the reaction, and the results are correlated with the work of Lenher and Rollefson on the photochemical formation of phosgene. F. J. B.

1449. Photochemistry of Mixtures of Chlorine, Oxygen and Carbon Monoxide. G. K. Rollefson. *Am. Chem. Soc., J.* 55. *pp.* 148–152, *Jan.*, 1933.—A determination of the relative amounts of carbon dioxide and phosgene was made, the formation taking place when mixtures of carbon monoxide chlorine and oxygen were illuminated by the light absorbed by the chlorine. It was found that the relative amount of the two reactions was a function solely of the ratio of chlorine to oxygen, provided that the temperature was kept constant. F. J. B.

1450. Anomalous Decomposition of Ozone in the Presence of Chlorine. L. J. Heidt, G. B. Kistiakowsky and G. S. Forbes. *Am. Chem. Soc., J.* 55. *pp.* 223–231, *Jan.*, 1933.—The decomposition of ozone in the presence of chlorine has been re-investigated [see Abstract 5346 (1932)] at 2, 13 and 22° C. in quartz and in pyrex at 23, 35 and 50° C., with great care in pressure measurement, temperature control and avoidance of contaminations. As precautions became more stringent, the speed of the dark reaction, following a brief exposure to light, an increase in temperature or even a period in the dark at 2, 13 or 23° C., tended to increase surprisingly. After this, an equally striking decrease often occurred. The time intervening before inception of the fast reaction decreased with an increase in the temperature and was shortened by absorption of light by chlorine. Uncontaminated ozone, without chlorine, gave a fast dark reaction at the start which died down during the first 2½ hours and could not be restored during the next seven days by light of any available wave length or by temperature changes. The fact that light is readily capable of starting the "fast" reaction is evidence for the essential similarity, if not identity of the mechanisms of light and dark reactions. No mechanism, however, seems to fit all the experimental data and discussion is reserved. H. H. Ho.

1451. Application of Blair-Leighton Equation to X-Rays. J. A. Lester and J. M. Blair. *J. Phys. Chem.* 37. *pp.* 17–27, *Jan.*, 1933. —Describes a method for evaluating the ideal maximum developable density, this being the density a photographic plate would have if every grain of silver halide were developed. An equation for the rate of formation of the latent photographic image previously derived for visible radiation [see Abstract 4270 (1932)] is also found to fit the image produced by X-rays of constant intensity. A. H.

1452. Action of Developer on Latent Images of Different Ages. C. Jausseran. *Comptes Rendus,* 195. *pp.* 1260–1262, *Dec.* 19, 1932.— A hydroquinone developer renders light values after exposures of several hours apart if development lasts at least 12 min. A metol developer, which, with a development of 4 min., introduces errors in density which may amount to 25 %, may be rendered more accurate by prolonging the development by means of KI, but it is difficult to avoid chemical veiling. E. E. F. d'A.

1453. Influence of Alkali Iodides on the Solarisation of Photographic Emulsions. A. Charriou. *Comptes Rendus,* 196. *pp.* 172–174, *Jan.* 16, 1933.—The recent work of Arens [see Abstract 3994 (1930)] has shown (1) that the presence of alkali bromides in an emulsion renders it liable to solarisation, (2) that the presence of halogen accepters prevents solarisation, and (3) that microscopic examination shows that bromided grains are larger than non-bromided ones. These experiments with alkali iodides indicate that the emulsions so obtained are some thousand times more sensitive to solarisation than any others, being capable of giving completely solarised images with instantaneous exposures. J. E.

1454. Uses of Dyes in Photography. O. Bloch. *Phot. J.* 73. *pp.* 2–9; *Disc.*, 9–10, *Jan.*, 1933.—A review of the various rôles played by dye-stuffs in photography with some account of the theories involved. The subjects discussed are (1) sensitising, (2) light filters and safe lights, (3) colour photography, (4) desensitisers, and (5) anti-halation layers. A. H.

1455. Time of Exposure for Autochromatic Photography. F. Lapeyre. *Soc. Franç. Phot. et Ciné., Bull.* 19. *pp.* 248–254, *Dec.*, 1932.— From a study of the sensitometry of the autochromatic emulsion, it is found possible to determine the exposure time, for any subject, sufficiently accurately to enable development to be automatic and to be performed in complete darkness. The time of development must be less than 5 minutes duration, as above this time a dominant blue coloration manifests itself; thus the exposure time must be sufficient to enable development to be completed within this time. An examination of the characteristic curves shows that the development time has a minimum of 1 minute 45 seconds. Further if an impression of white or colour is to be obtained, the brightest part of the image must have a density of deposited silver of 0·15, so that for any given time of development there is a corresponding exposure time determined by the brightness of the part of the subject corresponding to the brightest part of the image. It is not possible to reduce the exposure time and increase the time of development up to 5 minutes, as the details in shadow will not be clearly defined, there being a definite exposure time for a contrast of 100 which will correspond to the minimum development time. By reducing the exposure time and increasing the time of development the contrast which is reproduced is decreased. Finally, the relation between the brightness of the most luminous part of the subject and the exposure time is examined, since this enables the normal exposure time for any brightness and aperture to be calculated. Thus it is advisable to measure the brightness of the most luminous part of the subject and that for the details in shadow if the exposure time is to be estimated with any degree of accuracy. R. C. F.

1456. Photometric Determination of Camera Exposures for Motion Picture Work. M. Gundelfinger and W. Stafford. *Frank. Inst., J.* 215. *pp.* 81–92, *Jan.*, 1933.—A photometric method for the determination of camera exposures in motion picture work is described. The relation of exposure, object brightness and lens stop number is derived, and the proportionality constant empirically determined for " Pan Astro " lenses of 2 and 3 in. focal length. A nomographic chart of the exposure relation is given to simplify the determination of the lens stop number to be used for a given object brightness. AUTHORS.

1457. Influence of Pressure on the Photographic Sensitivity at Different Monochromatic Radiations. N. Tsize and C. Ling-Chao. *Comptes Rendus*, 196. *pp.* 107–108, *Jan.* 9, 1933.—The ratio $E/E_o = 1 + ap$ [see Abstract 3720 (1932)], where E_o and E are the respective effects under normal and pressure p conditions, has now been investigated for the different monochromatic radiations of the mercury arc. The following table summarises the results :

	5791Å 5770Å	5461Å	4917Å	4358Å	4047Å	3655Å	3341Å	3131Å
a	0·00067	0·00065	0·00057	0·00023	0·00013	0·00008	0·00004	0·00003

H. H. Ho.

1458. Dimensions of the 16-mm. Sound Film. R. P. May. *Soc. Franç. Phot. et Ciné., Bull.* 19. *pp.* 254–262, *Dec.*, 1932.—This paper, which is an extract of a paper published in the Journal of the Society of Motion Picture Engineers, April 18, 1932, describes a method whereby it is possible to determine the dimensions of the sound film by considering all the possible variations. There are two methods of obtaining 16-mm. films—one by contact printing using a 16-mm. negative obtained by projection from a 35-mm. sound film, and the other giving a 16-mm. positive direct by optical reduction and projection using a 35-mm. negative. The method described, which is suitable for both means of deriving the 16-mm. film, consists of drawing a diagram of successive errors which add to or subtract from the original dimensions of the picture and sound images used in its production, such errors arising from differences in the dimensions of the winding gear and films and contraction during chemical treatment. Owing to the improbability of all the errors occurring in one film it has been found possible to use standard projector dimensions and a 16-mm. film with only one row of perforations and a sound trace of 0·15 mm. The errors are considered in detail and then the method of obtaining the diagram from the values of the errors is given, the same final dimensions being obtained irrespective of the method used for the production of the film.

R. C. F.

See also Abstracts 1459, 1461, 1478.

PHOTOMETRY.

1459. Recording Microphotometer. B. Lange. *Zeits. f. techn. Physik*, 13. 12. *pp.* 600–606, 1932.—Gives a detailed description of the principle, mode of construction and use of a microphotometer depending on the employment of a photovoltaic cell. Since this type of cell requires no external battery, the apparatus can be made much simpler than in the case of an instrument using an alkali cell. The instrument described can be used for measuring the density at any given point of a photographic plate, or it can be used to give a photographic record of the variations of density along a given line, *e.g.*, along a spectrum photograph. In the latter case the spectrum photograph under examination, and the plate on which the variations of density are to be recorded, are moved respectively by two synchronous motors supplied from the same network. J. W. T. W.

1460. Rapid Spectrophotometry of Liquids in the Ultra-Violet Region. F. Twyman. *Phys. Soc., Proc.* 45. *pp.* 1–18; *Disc.*, 18–19, *Jan.* 1, 1933.—The paper describes an instrument for the rapid spectrophotometry of liquids by the spectrographic method. A single exposure, usually of less than 20 sec., results in a set of spectra which embodies all that is necessary for plotting an absorption curve. AUTHOR.

1461. Preparation of Circular Neutral Absorption Wedges. G. Haase. *Zeits. f. Instrumentenk.*, 52. *pp.* 529–534, *Dec.*, 1932.—Describes a cheap process for the production of photographic neutral wedges in disc form, for use in photometric work. The method consists in placing before a photographic plate a double sector disc. Each of the two parts consists of a half-disc of metal, suitably blackened. One disc rotates at half the speed of the other, so that the exposure of the plate gradually increases from zero to full as both discs rotate in the same direction. A tungsten strip lamp provides the light and it is possible to obtain different rates of variation of wedge transmission by altering the candle-power of the lamp as the discs rotate or by using plates with different characteristics. J. W. T. W.

See also Abstracts 1381, 1521, 1594.

POLARISATION.

1462. Action of Aluminium Salts on Alkali Tartrates. Yeu-Ki-Heng. *Comptes Rendus*, 196. *pp.* 259–261, *Jan.* 23, 1933.—Curves relating rotation to x for solutions containing $x/2$ cc. of $N/4$ $Al_2(SO_4)_3$, $(20-x)$ cc. of $N/2$ sodium tartrate, and $x/2$ of $3N/2$ NaOH, and for solutions containing similar volumes of solutions of double the foregoing concentrations have been determined. They indicate that the compounds $Al[Al(C_4H_4O_6)_3]$ and $Na_3[Al(C_4H_4O_6)_3]$ are formed, containing the complex $[Al(C_4H_4O_6)_3]^{III}$. This is confirmed by the fact that in the aluminium salt only half the Al is precipitated by sodium phosphate, and in the sodium salt none. C. A. S.

See also Abstract 1473.

RADIATION, EMISSION.

1463. Radiation in Gaseous Explosions. W. T. David and R. M. Parkinson. *Phil. Mag.* 15. *pp.* 177–192, *Jan.*, 1933.—Radiation measurements in explosions of mixtures containing CO, H_2, CO and H_2 in different proportions, CH_4, C_2H_2 and C_2H_4, are recorded and discussed. The total radiation emitted during the explosion and subsequent cooling of CO mixtures was greater than that emitted by H_2 mixtures of comparable strength. In mixtures containing CO and H_2 in varying proportions the total radiation decreased with increase of hydrogen content. The greater part of the total radiation from the exploded gases is emitted during the cooling period, and is therefore mainly of thermal origin. J. S. G. T.

1464. "Black Body" of Carbon Heated Electrically. T. N. Panay. *Comptes Rendus,* 195. *pp.* 1256–1258, *Dec.* 19, 1932.—The radiator is a 1 mm. aperture in a hollow carbon cylinder 20 mm. long, mounted in the centre of a pyrex glass bulb and heated by means of a current of about 500 A led in by copper conductors having a cross-section of 65 mm². This conductor forms the secondary of a transformer designed to furnish a heavy current with an output of 5 kW. The temperature normally attained is 2200°K. E. E. F. d'A.

1465. Simple Method for the Evaluation of Planck's Radiation Equation. H. Stoll. *Zeits. f. techn. Physik,* 14. 1. *pp.* 44–46, 1933.—Planck's equation, which gives for black radiation the intensity distribution as a function of temperature and wave-length, has the form $J_\lambda = (3{\cdot}17 \times 10^{-8} \times \lambda^{-5})/(e^{1{\cdot}43/\lambda T}-1)$ k.cal/*m*²*h* cm. Curves between intensity and wave-length are given for temperatures of 1000° and 1200°C. in cartesian co-ordinates, and curves for 20°C., 1000°C. and 8000°C. in the logarithmic co-ordinate system ; the latter have practically the same form for different temperatures. The short wave-length part of the curves are nearly congruent since the "1" in the denominator of the equation can then be neglected. For larger wave-lengths this is not permissible. The curves show that the position of the maxima can be approximately obtained from the equation $\log J_{max} + 5 \log \lambda_{max} = 10{\cdot}329$. The approximate equation $\lambda_{(J_{max})} = 2860/T$, obtained from Planck's equation, also enables the position of the maxima to be fixed in the diagram. T. B.

1466. Deflection of Cosmic Rays by a Magnetic Field. L. F. Curtiss. *Bureau of Standards, J. of Research,* 9. *pp.* 815–823, *Dec.,* 1932.—Using 4 Geiger-Müller tube counters, coincidences produced by cosmic rays are observed with and without a magnetic field of 7000 gauss. The arrangement is such that electrons in the beam, possessing energies $< 10^9$ V are prevented from causing coincidences. Observations are made for a total of 615 hours without the field and 508 hours with the field, in alternate periods of about 48 hours. The average number of coincidences without the magnetic field is found to be $1{\cdot}13 \pm 0{\cdot}09$ per hour and with the magnetic field $0{\cdot}88 \pm 0{\cdot}14$ per hour. For approximately 70% of the cosmic ray particles deviation is less than for 10^9 V electrons. The results are in disagreement with those of Rossi and of Mott-Smith ; it is considered that the previous results were affected by scattering or absorption in the iron core producing the magnetic field. F. C. C.

1467. Dependence on Pressure and Temperature of Cosmic-Ray Ionisation. B. Gross. *Zeits. f. Physik,* 80. 1–2. *pp.* 125–133, *Jan.* 6, 1933.—The dependence on pressure of the ionisation in air and in N and its dependence on the ioniser are considered. The equation deduced from Jaffé's theory for the current-pressure curves is extended by introduction of the temperature, and compared with experiment. A temperature effect caused by space charges is discussed. J. J. S.

See also Abstract 1437.

RADIATION, GENERAL THEORY.

1468. Equilibrium between Radiation and Matter in the Universe. A. Ganguli. *Phil. Mag.* 15. *pp.* 65–72, *Jan.*, 1933.—Various mechanisms by which radiation and matter might conceivably be interconvertible are considered and discussed. J. H. A.

RADIATION, MECHANICAL EFFECTS.

1469. Radiation Pressure by Refraction. C. Bellia. *N. Cimento*, 9. *pp.* 328–334, *Dec.*, 1932.—Proves mathematically that a refracted beam of light exerts a pressure at right angles to the refracting surface and also along it (this force was experimentally discovered by Poynting and Barlow [see Abstracts 1377 (1905), 1677 (1912) and 967 (1913).] E. E. F. d'A.

1470. Motion of Suspended Particles in Glycerin and Water. J. H. Smith. *Phil. Mag.* 15. *pp.* 15–19, *Jan.*, 1933.—Suspensions of iron in glycerin prepared for some magnetic experiments are subjected to light rays in the same way as Barkas [see Abstract 2838 (1930)] treated water suspensions. The results are similar. The cloud formations, ascribed to photophoresis of colloidal particles, are probably due to very slow eddy currents and these denude the stagnant liquid of suspended particles. A similar boundary is produced by transverse heating in pure glycerin, the appearance of the boundary being that of a crack in thick glass. H. M. B.

REFLECTION. REFRACTION AND DISPERSION.

1471. Reflecting Power of Very Thin Films of Metals. P. Rouard. *Comptes Rendus*, 195. *pp.* 869–870, *Nov.* 14, 1932.—Thin films of metals are sputtered on a face of a glass prism of 2° to 3° angle. A method is given for determining the thickness of the films to within 2 or 3 tenths of a milli-micron. Preliminary experiments with silver show that the results agree accurately with those obtained by other methods. A simple method of determining the reflection power for various wave-lengths in the visible region is described, and results are given for gold and silver. It is found that light which has been reflected from the metal at the glass-metal surface has different colours according to the thickness of the film. H. L. B.

1472. Preparation of Residual-Ray Plates and the Reflection Power of Powders. R. B. Barnes. *Phys. Rev.* 43. *pp.* 31–33, *Jan.* 1, 1933.—Residual-ray plates were prepared (1) of natural crystal surfaces, (2) of surfaces of fused and then recrystallised substances, and (3) of pressed crystal powders. The residual-rays resulting from reflection upon these three types of surfaces were compared. The wave-length of the reflection maxima was in each case the same. The intensity of the residual-rays of type (2) was the same as that of type (1). The reflection power of the third type, the pressed powders, depended inversely upon the size of the particles of powder. It is shown that (in cases where no pressure is applied to the surface) the reflection power of a powder decreases as the particle size is made smaller. AUTHOR.

1473. Reflection of Light at a Surface Covered by a Monomolecular Film. C. Strachan. *Cambridge Phil. Soc., Proc.* 29. *pp.* 116–130, *Jan.* 31, 1933.—The polarisation of light reflected at the plane surface of separation of two media depends on the optical condition of this surface. The case of a surface covered with a monomolecular film is treated mathematically, an attempt being made to find the effect of a two-dimensional assembly of scattering centres. C. B. A.

1474. Geometrical Optics of Aspherical Surfaces. H. R. Schulz. *Zeits. f. Physik,* 79. 11–12, *pp.* 843–851, *Dec.* 30, 1932.—The range of application of geometrical optics can be extended by the investigation, based on known conic constructions, of refracting surfaces which can be treated as resulting from the rotation of curves of higher degree, and also by the application of the relationships of geometrical optics to media with continuously variable refractive index. C. B. A.

1475. Light Rays and Wave Surfaces in General Anisotropic Bodies. P. Frank. *Zeits. f. Physik,* 80. 1–2. *pp.* 4–18, *Jan.* 6, 1933.—A mathematical discussion in which the vector analysis method of Sommerfeld and Runge for the optics of rays is extended to media of general anisotropy, *i.e.*, to media in which the refractive index depends in an arbitrary way on the ray direction. As an example of a case of anisotropy which does not occur in ordinary crystal optics, the ray-optics in a moving medium is investigated. C. B. A.

1476. Pauly Method of Determining Refractive Indices of Liquids. F. C. Phillips and W. A. Wooster. *Zeits. f. Krist.* 84. *pp.* 318–320, *Jan.*, 1933. *In English.*—The Pauly method of determining the refractive index of a liquid by placing a spot on the surface of a plate of a doubly-refracting crystal, and rotating above a polariser until irregularities on the surface become invisible, is shown to be invalid. C. B. A.

1477. New Universal Refractometer with Internal Reading. P. Lob. *Zeits. f. Instrumentenk.* 53. *pp.* 27–30, *Jan.*, 1933.—Particulars are given of a new type of Askania universal refractometer which has a range of working for refractive indices of 1·333 to 1·54. It possesses the advantage that the scale used to determine angles of refraction is visible in the field of view of the telescope at the same time as the object is viewed. Results are shown for a series of tests on mixtures of alcohol and water for large and small percentages of alcohol. The results give an accuracy of reading and reproducibility of at least 0·0001 for the refractive index corresponding to 0·06% for the dry substance or 0·15% of alcohol in an alcohol-water mixture. R. S. R.

1478. Defects of Large Aperture Objectives. G. Bonnerot. *Soc. Franç. Phot. et Ciné., Bull.* 19. *pp.* 241–248, *Dec.*, 1932.—The use of lenses of increasing apertures but of the same construction results in a decrease in the definition obtained from the edges of the lenses, but this is accompanied by a gain in the light transmitted. As the aperture of lens is increased the number of air-glass surfaces, cemented surfaces, and glass thicknesses increases if the aberrations are to be corrected, thereby resulting in a loss of light transmitted. The loss of light due to reflection at the air-glass contact surfaces and by absorption in the lenses themselves is examined theoretically, whilst if the balsam cement is new it results in a 1% loss for each layer, the results showing that with objectives of very large aperture and of fairly long focal lengths the light absorption becomes very high. A limit is quickly reached in which the gain obtained due to the aperture is neutralised by the loss due to absorption. An examination of

two Zeiss lenses of $f3\cdot5$ and $f1\cdot4$ respectively, shows that 66% of the light is transmitted in the case of the $f3\cdot5$ lens, but for the $f1\cdot4$ lens it has decreased to 45%, the theoretical gain of $5\cdot8$ obtained by using the $f1\cdot4$ lens being far from correct owing to the 20% additional absorption.
R. C. F.

1479. Advantages and Disadvantages of the Dispersion in the Plate Prism of the Lummer-Gehrcke Plate. Magdalena Adam. *Zeits. f. techn. Physik*, 14. 1. *pp.* 26–31, 1933.—The dispersion in the plate prism of the Lummer-Gehrcke plate makes necessary the repeated readjustment of the plate when working over any but a small wave-length range, and this is particularly inconvenient in the ultra-violet. Auxiliary prisms are described which can be used to eliminate the plate prism dispersion. Conversely, the dispersion can be accentuated by means of an auxiliary prism, and this is useful for certain purposes. W. S. S.

See also Abstracts 1272, 1425, 1520, 1653, 1657.

SPECTROSCOPY.

1480. First Spectrum of Xenon. C. J. Humphreys and W. F. Meggers. *Bureau of Standards, J. of Research*, 10. *pp.* 139–149, *Jan.*, 1933.—An entirely new description of the spectrum of xenon is given. Geissler tubes with a small bore capillary exposed end-on are used as sources and afford sufficient intensity to permit of the use of spectrographs of high-resolving power to a greater extent than in the investigations previously reported [see Abstracts 1457 (1930), 1251 (1931) and 454 (1932)]. The new description covers the region between λ3340 and λ11,140. Interferometer measurements are made on 130 lines. Several new lines are found in the ultra-violet between λ3340 and λ3440 where the use of a source of higher intensity has led to the detection of several higher members of the $ls_5 - mp_t$ series. Most of the new data have been obtained in the infra-red region. It is believed that the spectrum has been completely recorded throughout the region investigated. Of the 538 lines included in the description all but 13 have been classified and almost all terms predicted by the Hund theory have been obtained. A. H.

1481. Arc Spectrum of Sulphur. R. Frerichs. *Zeits. f. Physik*, 80. 3–4. *pp.* 150–160, *Jan.* 23, 1933.—The arc spectrum of sulphur was investigated in the long-wave region with large dispersion. Of the term series belonging to the state ^4S of the ion the quintet series was completed, and the triplet series is newly constructed. Of the terms related to state ^2D of the ion the terms ^3D or ^3P and ^3F belonging to the configurations 4s or 4p are found. J. J. S.

1482. Interferometer Measurements in the Extreme Ultra-Violet Region of Copper. J. C. McLennan and F. M. Quinlan. *Roy. Soc. Canada, Trans.* 26. *pp.* 19–24, *May*, 1932.—A copper arc of the Pfund type is employed, the interference system being a Fabry and Perot étalon combined with a Hilger E1 quartz spectrograph. Various secondary standards and some iron lines recently measured by Jackson [see Abstract 1225 (1932)] are used as reference lines. Thirteen lines lying between λ2320 and λ2085 are studied and their wave-lengths evaluated. A. H.

1483. Quantitative Spectrum Analysis. Parts V, VI, VII and VIII. A. Iwamura. *Kyoto Coll. Sci., Mem.* 15. *pp.* 355–372, *Nov.*, 1932. *In English.* Part V.—The electrodes used for the determination of rubidium chloride in carnallite were prepared from artificial carnallite, zinc oxide, and hydrochloric acid; the sensitivity of the method is $1 \cdot 2 \times 10^{-2}$ %. Both the comparison and graphical methods are satisfactory. Part VI.—A mixture of gold ore and cane sugar molasses, with carbon to increase the conductivity, or of ore with zinc oxide and hydrochloric acid, yields electrodes suitable for the determination of gold in the ore; magnesia or lime cement may be used also. The resulting spectrograms are reproducible, the sensitivity for the gold line at 2428Å being 4×10^{-4} % for electrodes containing carbon, and 3×10^{-3} % for the zinc oxide electrodes. Elements such as silicon and calcium, which have a lower ionisation potential than gold, reduce the sensitivity. The comparison method is not satisfactory. Part VII.—The logarithmic photographic density–concentration curves obtained with electrodes containing gold and/or silver are linear for the lines 2676 and 2428Å (gold) and 3383 and 3281Å (silver). The values of the ratio gold : silver calculated from the concentrations obtained by interpolation from the appropriate curves are in fair agreement with the actual values. Part VIII.—It is possible to determine the quantity of each salt in a mixture of two salts having the same anion or of each element in a binary mixture of oxides by determining spectrographically the concentration ratio and weighing the two as chloride, sulphate, or oxide.

H. F. G.

1484. Spectroscopic Applications of the Electrodeless Discharge. G. Déjardin. *Canad. J. of Research*, 7. *pp.* 556–570, *Dec.*, 1932.—A general article on the electrodeless discharge in which it is pointed out that it forms one of the best ways of separating spectra due to different degrees of ionisation. The rare gases, mercury and phosphorus are considered in detail, and a Bibliography is given. F. S.

1485. H.F. Discharge in Helium and Mercury. E. Matuyama. *Tohoku Univ., Sci. Reports*, 21. *pp.* 928–935, *Dec.*, 1932. *In English.*—The intensities of various lines in the two spectra were measured at various pressures. Excitation probabilities have been studied by Hanle and others, and with reference to this, other conditions of excitation such as velocity of electrons were investigated. F. S.

1486. Extension of the First Spark Spectrum of Caesium (Cs II). J. Olthoff and R. A. Sawyer. *Phys. Rev.* 42. *pp.* 766–776, *Dec.* 15, 1932.—The classification of the Cs II spectrum recently made by Laporte, Miller and Sawyer [see Abstract 2434 (1932)] is extended, the original observations being confirmed and the range of the observations increased so that the whole of the region λ2300–λ10,000 is covered. An electrodeless discharge in caesium vapour is used as a light source, the spectra being photographed by means of a 21-ft. grating and a Hilger E1 quartz spectograph. Most of the terms of the $5p^5({}^2P_{\frac{1}{2}})5d$, $6d$, $6s$, $7s$ and $6p$ configurations are located, as well as a few new terms belonging to the $5p^5\ {}^2P_{1\frac{1}{2}}$ limit. A. H.

1487. Measurement of the Intensity-Ratio of the Boron Isotopes B^{10} and B^{11}. L. S. Ornstein and J. A. Vreeswijk, Jr. *Zeits. f. Physik*, 80. 1–2. *pp.* 57–58, *Jan.* 6, 1933.—The ratio of the boron isotopes is measured from the line λ2497·7 (${}^2P_{\frac{1}{2}} - {}^2S_{\frac{1}{2}}$) and is found to be $B^{10} : B^{11} = 1 : 4 \cdot 43$, giving an atomic weight of 10·816. The method was not suitable for the measurement of other lines. The distance between the components of the line was 0·054Å. J. E. K.

1488. Line Spectrum of Samarium Ion in Crystals and its Variation with Temperature. S. Freed and J. G. Harwell. *Am. Chem. Soc., J.* 55. *pp.* 54–62, *Jan.*, 1933.—The absorption spectra of Sm^{+++} in the hexagonal crystal $Sm(C_2H_5SO_4)_3 . 9H_2O$ were taken parallel to the optic axis at 20, 77 and 169°K. Absorption lines are listed in the region of the spectrum between 4200Å and 2200Å. This paper is principally concerned with the various electronic configurations in the basic multiplet, especially as they result from the interaction of Sm^{+++} and the electric fields of the lattice. In consequence, all the lines whose relative intensities vary with the temperature have been studied in terms of energy level diagrams. H. H. Ho.

1489. Reversal Measurements on Spectral Lines and the Determination of the Total Absorption and the Relative Populations of Excited Atomic States. H. Kohn. *Phys. Zeits.* 33. *pp.* 957–963, *Dec.* 15, 1932.—The experimental method was to form an image of an arc crater within a selectively emitting and absorbing gas. The emerging light was then passed through a spectrometer and photographs were taken corresponding to different brightnesses of the arc obtained by interposing a rotating sector between the arc and its image in the gas. The spectrum photographs showed the continuous spectrum of the arc together with the lines of the gas, the latter being brighter or darker than the continuous background depending on the transmission of the sector employed. By microphotometry of the plates it was possible to obtain for any given line the excess of the radiation emitted over that absorbed by the gas, for each sector. Plotting this quantity against the sector transmission a graph is obtained from which the ratio of the populations in the initial and final atomic states giving rise to the selected line, can be deduced. Information is also yielded as to the total absorption and relative transition probabilities. Using this method, a number of neon lines have been studied and the relative populations of various excited states have been determined for different conditions of excitation, namely different pressures and current densities. W. S. S.

1490. Nuclear Moment of Indium. D. A. Jackson. *Zeits. f. Physik*, 80. 1–2. *pp.* 59–66, *Jan.* 6, 1933.—The value $I = 1$ for the nuclear moment of indium was deduced in a previous paper [see Abstract 124 (1931)]. This value was deduced by applying the interval rule to the separations of the components of λ4511 and since it appears that the components were not all completely resolved the value $I = 1$ can no longer be accepted. The nuclear moment is therefore re-determined by a careful measurement of the intensities of the hyperfine structure components of λ4101, a line which can with certainty be completely resolved. An exceedingly accurate photometric method for determining the intensities of the components is developed and the intensities are measured over a large range of vapour pressure of the indium trichloride which emits the spectrum. It is found that the intensities are independent of the vapour pressure and in extremely good agreement with the theoretical intensities calculated for the value $I = 9/2$ for the nuclear moment. This value must henceforth be adopted. J. E. K.

1491. Multiplet Separation in the Spectra of Atoms with Two Outer Electrons. H. C. Brinkman. *Zeits. f. Physik,* 79. 11–12. *pp.* 753–775, *Dec.* 30, 1932.—Mathematical. A perturbation method is applied to the determination of the interaction of the two electrons.
H. F. G.

1492. Width of Spectral Lines in Gases. V. Weisskopf. *Phys. Zeits.* 34. *pp.* 1–24, *Jan.* 1, 1933.—The factors affecting width are divided into two classes—those affecting isolated atoms, and those due to interaction, and are dealt with separately. The first comprise natural width and Doppler width, while among the latter the effects of impact and coupling and of the Stark effect are considered. A comprehensive Bibliography is given.
F. S.

1493. Wigner's Extension of the Thomas-Kuhn Summation Law for an Electron in a Central Field. H. A. Kramers, C. C. Jonker and T. Koopmans. *Zeits. f. Physik,* 80. 3–4. *pp.* 178–182, *Jan.* 23, 1933.—The values $(l + 1)\ (2l + 3)/3(2l + 1)$ and $-\,l(2l - 1)/3(2l + 1)$ are calculated by a method different from that of Wigner [see Abstract 3807 (1931)] for those partial sums which correspond to transitions, $\Delta l = +\,1$, $\Delta l = -\,1$, from the sum of the intensities of absorption of all spectral lines that start out from one level. The summation law is briefly discussed from the point of view of Dirac's theory of the electron.
H. L. B.

1494. Barium Hydride Band Spectra in the Near Infra-Red. W. W. Watson. *Phys. Rev.* 43. *pp.* 9–11, *Jan.* 1, 1933.—A BaH band system with principal heads at 8924Å and 9017Å degraded to the red is ${}^2\Sigma \rightarrow {}^2\Sigma$ with the same lower ${}^2\Sigma$ as for the ${}^2\Pi \rightarrow {}^2\Sigma$ BaH bands in the visible red region. For the upper ${}^2\Sigma$ state $B_0 = 3\cdot232$, $D_0 = -\,1\cdot323 \times 10^{-4}$ and $\gamma_0 = -\,4\cdot84$. This very large spin doubling indicates interaction with a near-lying lower ${}^2\Pi$ state which computation shows to be the probable upper state of another BaH band observed on the long wave-length side of 10,052Å. The nature of the electron configurations in the several BaH states is discussed.
AUTHOR.

1495. Spectrum of the Corona Discharge in Air, Oxygen and Nitrogen. A. C. Young and A. G. Creelman. *Roy. Soc. Canada, Trans.* 26. *pp.* 39–42, *May,* 1932.—The corona discharge in nitrogen, air and oxygen is examined under low dispersion. In the case of oxygen two faint bands (not identified) are observed near λ6000. The nitrogen spectrum consists mainly of the second positive group of bands whilst the spectrum of the discharge in air does not differ essentially from that in nitrogen. The results in air are not in agreement with those of Zebrowski [see Abstract 1451 (1930)], who concluded that most of the radiation was due to spark lines of air.
A. H.

1496. Origin of the Mercury Bands at 2480 Å. J. G. Winans. *Phys. Rev.* 42. *pp.* 800–806, *Dec.* 15, 1932.—The group of 8 bands near 2480 Å was photographed under varied conditions in order to determine their origin. The source was a discharge through a mercury-vapour quartz tube, with external electrodes from a Tesla coil. The bands are weakened by heat. The origin is undoubtedly molecular. The most probable forms are Hg^{+}_{2} and Hg_{2}. Five observations favour Hg^{+}_{2}: (1) they have never been observed in fluorescence; (2) the 2476 band is stronger than the 2345 under strong excitation, but weaker under low field excitation; (3) no other bands with properties like those of the 2480 group have been observed in the Hg spectrum, and Rayleigh has shown that these bands do not occur in absorption; (4) the bands in this series may be classified as sequencies $\nu'-\nu'' = 0 \pm 1 \pm 2 \pm 3$, and a lower limit for D of $\sim 0 \cdot 3$ volt is estimated; (5) in the $\nu'-\nu'' = 0$ sequence emission is observed from state $\nu' = 41$ indicating molecules with very high vibrational energy. This energy may be supplied by the field if the emitter is an ion, but not if it is a neutral molecule. AUTHOR.

1497. Diffuse Band Accompanying the D-Lines. K. Wurm. *Zeits. f. Physik*, 79. 11–12. *pp.* 736–741, *Dec.* 30, 1932.—The band is found on the shorter wave-length side in an arc discharge. It is ascribed to a polarised Na_2 molecule. Similar bands were predicted and found for Tl, Mg and Ca. F. S.

1498. Chappuis Ozone Bands and the Boric Acid Spectrum. E. Walles. *Zeits. f. Physik*, 80. 3–4. *pp.* 137–149, *Jan.* 23, 1933.—The spectrum of boric acid has been examined and compared with Wulf's values for ozone. On account of the similarity in character, position and intensity, these spectra are concluded to be identical. F. S.

1499. Band Spectrum of CO^+. D. Coster, H. H. Brons, and H. Bulthuis. *Zeits. f. Physik*, 79. 11–12. *pp.* 787–822, *Dec.* 30, 1932.—The spectrum excited by a hollow kathode was photographed by a large grating. The rotation structure of $\Sigma \rightarrow \Sigma$ bands and of $\Pi \rightarrow \Sigma$ bands is given and each band is found to have 12 branches. F. S.

1500. Infra-Red Absorption Spectrum of Hydrogen Cyanide. K. N. Choi and E. F. Barker. *Phys. Rev.* 42. *pp.* 777–785, *Dec.* 15, 1932.—The infra-red absorption spectrum of hydrogen cyanide gas between 3 and 15μ has been investigated using a grating spectrometer and a thermo-relay. Potassium bromide windows were used on the absorption cells and are effective throughout the whole spectral range. Previous investigators had observed broad double maxima at 14μ, but the authors have succeeded in resolving this band into *P*, *Q*, and *R* branches. The *Q* branch is very intense. Another band at 7μ is the first harmonic of the band at 14μ and has two maxima of almost equal intensity and no *Q* branch. Three maxima, less intense and unsymmetrical, were found at 4·728, 4·760, and 4·794μ. A single absorption band was found at 3·57μ and the band found by Burmeister at 3μ was resolved into a doublet with maxima at 2·996 and 3·045μ, neither of which could be resolved. Appropriate quantum transitions have been assigned to each band. The molecule is linear and has three fundamental frequencies, $\nu_1 = 2100$ cm.$^{-1}$, $\nu_2 = 712$ cm.$^{-1}$, and $\nu_3 = 3289$ cm.$^{-1}$; the value of ν_1 is computed. The moment of inertia, calculated from the fine structure of the 14μ band, is $18 \cdot 68 \times 10^{-40}$ gm.cm. W. R. A.

1501. Chemical Aspects of the Infra-Red Absorption Spectra of the Ethyl Halides. P. C. Cross and F. Daniels. *J. Chem. Phys.* 1. *pp.* 48–55, Jan., 1933.—The infra-red absorption spectra of ethyl, chloride, ethyl bromide and ethyl iodide have been determined with a prism spectrometer between 1·5μ and 15μ. Eight experimentally observed fundamental frequencies have been selected which, together with their first harmonics and simple combinations, are shown to account for the entire spectrum. A type of vibration between atom pairs believed to represent the important feature of the motion of the atoms is suggested for each of these fundamentals. The shifts in the absorption maxima produced by the substitution of the different halogens together with absorption and Raman data of related compounds are used in selecting these types of vibration. The bearing of these hypotheses on problems in chemical kinetics is discussed. AUTHORS.

1502. Infra-Red Absorption Bands of Ammonia. H. J. Unger. *Phys. Rev.* 43. *pp.* 123–128, *Jan.* 15, 1933.—Eight NH$_3$ absorption bands have been recorded in the spectral region 1·0 to 2·0μ with an automatic recording prism spectrometer. The fine structure of the bands shows that they all belong to the two general types, "composite" and "double." The 1·6μ band is composite like the 1·97μ band first resolved by Stinchcomb and Barker [see Abstract 2484 (1929)]. The intensity of the lines is very uniform, and the line spacing, 10·2 cm.$^{-1}$, agrees with that of the 1·97μ band, 9·98 cm.$^{-1}$. Bands arising from changes of the electric moment parallel to the symmetry axis are double, as was found in the 3μ and 10μ bands. The doublet spacing in the 10μ band is 33 cm.$^{-1}$, but only 1·6 cm.$^{-1}$ in the one at 3μ. Dennison has shown that the doublet spacing should rapidly decrease in the higher levels, and for harmonic bands the separation should be so large that they would not appear double. The 1·51μ and 1·22μ bands both appear as double, and have a separation of 30·3 cm.$^{-1}$ and 30·4 cm.$^{-1}$ respectively. Evidently the multiplicity of some of the higher levels is more evident than the present theory predicts. A. H.

1503. New Absorption Bands of Methane in the Ultra-Violet. R. Mecke. *Zeits. f. Astrophysik*, 6. 1–2. *pp.* 144–149, *Jan.* 18, 1933.—The study of the absorption-spectrum of a layer of methane 20·3m. thick at a pressure of 5 atmospheres has revealed five new bands at wave-lengths 8900, 8600, 8400, 7840 and 7250 Å respectively. Comparison with the spectra of planets leads to the conclusion that hydrocarbons are probably present in their atmospheres. G. C. McV.

1504. Absorption Spectra of Complex Salts of Cr, Mn, Ru, Rh, Pd, Re, Os, Ir and Pt. R. Samuel and A. R. R. Despande. *Zeits. f. Physik*, 80. 5–6. *pp.* 395–401, *Jan.* 31, 1933.—The absorption spectra of 13 complex cyanides and chlorides between about 2300 and 5000 Å have been determined. All compounds containing co-ordinatively bound chlorine atoms exhibit an absorption band in the neighbourhood of 5000 Å. Potassium platinochloride is anomalous in that its absorption does not conform to Beer's law. In general, the regularities observed are analogous to those previously reported [see Abstract 3451 (1931)]. H. F. G.

1505. Structure of the Third Positive Group of CO Bands. G. H. Dieke and J. W. Mauchly. *Phys. Rev.* 43. *pp.* 12–30, *Jan.* 1, 1933.—The third positive group of CO was photographed under high dispersion. The bands are $^3\Sigma \rightarrow {}^3\Pi$ transitions. The $^3\Sigma$-state shows many strong perturbations. The triplet separation is very small. Of the 15 branches which must be expected under these conditions, 14 are found and traces of the 15th. Nine of these branches are strong and can be traced to $K = 55$. The others are weak and present only for small values of the rotational quantum number K. The five edges which are characteristic for the bands of the third positive group are formed by the two O-branches and the three P-branches. The character of the Λ-doubling and the number of missing lines near the origin shows that the $^3\Pi$ state is a normal $^3\Pi$ state.

The values of the rotational constants are $B' = 1\cdot89$ for the initial and $B'' = 1\cdot686$ cm.$^{-1}$ for the final state from which follows that the values for the moments of inertia are $F' = 14\cdot7\cdot10^{-40}$ and $F'' = 14\cdot43\cdot10^{-40}$. Complete details are given for the $0 \rightarrow 0$ (2833), $0 \rightarrow 1$ (2977), $0 \rightarrow 2$ (3134), and $0 \rightarrow 3$ (3305) bands. AUTHORS.

1506. Theory of Vibrational Isotope Effects in Polyatomic Molecules. E. O. Salant and J. E. Rosenthal. *Phys. Rev.* 42. *pp.* 812–822, *Dec.* 15, 1932.—Following Dennison's general, non-central force treatment of the normal modes of vibration of symmetrical triatomic and tetratomic molecules, expressions are derived for the effects of isotopy on the normal frequencies. The isotope effect of any particular normal frequency depends on, and may serve to evaluate, the force constants of the molecule, but sums of certain isotope effects are independent of the constants. These sum-rules and relations between the various isotope effects for triatomic and tetratomic molecules are derived and discussed. Criteria of collinearity of the molecule may be derived from the isotope effects. J. E. K.

1507. Repulsion Exponents of Alkali Anhydrides. A. Krebs. *Zeits. f. Physik,* 80. 1–2. *pp.* 134–136, *Jan.* 6, 1933.—A discussion is given of the repulsion exponents of the alkali hydrides LiH and NaH in regard to the relations existing between them when calculated according to spectroscopy of the bands and according to lattice theory. J. J. S.

1508. Normal State of the Helium Molecule-Ions He_2^+ and He_2^{++}. L. Pauling. *J. Chem. Phys.* 1. *pp.* 56–57, *Jan.,* 1933.—With the use of wave functions constructed from hydrogen-like single-electron functions with an effective nuclear charge Z, the application of the variation method of treating the wave equation for the normal state of He_2^+, involving a three-electron bond, leads to the values $Z = 1\cdot833$, $r_0 = 1\cdot085$A, $D_e = 2\cdot47$ v.e., and $\omega_0 = 1950$ cm.$^{-1}$. The experimentally determined values (from the He_2 spectrum) are $r_0 = 1\cdot090$A, $D_e = 2\cdot5$ v.e., and $\omega_{\frac{1}{2}} = 1628$ cm.$^{-1}$. A similar discussion is given for He_2^{++} and certain of the molecular constants are predicted. A. H.

1509. Radiation Diffusion and Rapidity of Escape of Resonance Radiation from a Gas. C. Kenty. *Phys. Rev.* 42. *pp.* 823–842, *Dec.* 15, 1932.—The radiation diffusion is considered from the standpoint of the free paths of the diffusing resonance quanta as influenced by the Doppler and other line-broadening effects. Abnormally long free paths are found to be of such importance as to enable resonance radiation to escape from a body of gas faster than has usually been supposed. It is assumed that a large concentration of diffusing resonance quanta will, on the basis of Doppler broadening only, give rise to a characteristic excitation of atoms, as dependent on their speeds, which can be represented by a distribution function which will lie between two limiting distribution functions, namely, (1) Maxwell's distribution function, and (2) a distribution function expressing a lower relative excitation of the high-speed atoms than that of Maxwell, based on the excitation of all atoms as if by absorption of the core of the line. On the basis of (1) and (2) limiting expressions are derived for: (*a*) the fraction of emitted quanta traversing at least a given distance before absorption, (*b*) the diffusion coefficient, (*c*) the average square free path, and (*d*) the average free path. A fundamental difference between radiation diffusion and molecular diffusion is that whereas (*a*) decreases exponentially with the distance in the latter case, in the former case it decreases linearly with the distance. Thus very long free paths are found to be of relatively great importance in radiation diffusion. J. J. S.

1510. Equivalent Absorption Coefficient for Diffused Resonance Radiation. M. W. Zemansky. *Phys. Rev.* 42. *pp.* 843–847, *Dec.* 15, 1932.—It is shown that the ideas expressed in Kenty's theoretical paper [see preceding Abstract] (in which the emission and absorption of quanta by moving atoms is considered) when applied to the diffusion of resonance radiation in a layer of gas of finite thickness provide a method of calculating an equivalent absorption coefficient of the gas for all the frequencies due to the Doppler effect that are present in the diffusing radiation. This average absorption coefficient is calculated and compared with a similar quantity calculated on the basis of a different point of view by Samson. Both average absorption coefficients are discussed in connection with the author's experiments on the rapidity of escape of resonance radiation emitted from a slab of mercury vapour after the cut-off of the excitation. J. J. S.

1511. Raman Effect. A. Ganguli. *Phil. Mag.* 15. *pp.* 193–196, *Jan.*, 1933.—The author has already considered the Raman effect from the aspect of unimolecular reactions [see Abstract 2448 (1932)], the intensity ratios between the Stokes and anti-Stokes lines being deduced for the two cases when $h\nu \ll kT$ and $h\nu \gg kT$. The formula for the latter case has since been found to be in disagreement with the experimental results hence in the present work the original treatment is revised and the conclusions are brought into harmony with these results. Various errors in the original paper are corrected. A. H.

1512. Raman Spectrum of Ammonia in Aqueous Solution. A. Langseth. *Zeits. f. Physik*, 77. 1–2. *pp.* 60–71, *July* 19, 1932.—Using a high dispersion thermostatted spectrograph, the line at about 3,300 $cm.^{-1}$ is resolved into a number of diffuse components, of which 33 are measured. Variation in the concentration caused systematic variations in the component intensities, so allowing their allocation in a rotation vibration band. The structure is that of a symmetrical rotator, and comprises one strong Q branch ($\Delta J = 0$), two positive branches (R and S) and two negative ones (P and O) (*i.e.* $\Delta J = \pm 1$ and ± 2). The analysis shows that the molecule of the gas suffers very little deformation on solution, since the structure corresponds closely to that of the 3μ infra-red band. The two moments of inertia are calculated, and it is found that the moment of inertia about the 3-fold axis (I_3) is smaller than the other moment of inertia ($I_2 = I_1$), in disagreement with the conclusions of other workers. The values obtained are $I_1 = I_2 = 2{\cdot}8 \times 10^{-40}$ $gm.cm.^2$ and $I_3 = 1{\cdot}4 \times 10^{-40}$ $gm.cm.^2$ [See also Abstract 2001 (1932).] A. C. M.

1513. Raman Spectra of Diphenylmethane, Aliphatic Bromides and Mercaptans. Elizabeth A. Crigler. *Am. Chem. Soc., J.* 54. *pp.* 4199–4206, *Nov.*, 1932.—Raman spectra are measured of diphenylmethane, normal butyl and normal hexyl bromides, and normal amyl, hexyl, and heptyl mercaptans. The work was undertaken with a view to information of the specific heats of these substances. Lines in the spectrum of diphenylmethane are characteristic of both aromatic and aliphatic linkages. The number of lines in the higher mercaptans increase with the length of the carbon chain. The values for the CS and SH vibrations are nearly the same in thiophenes, mercaptans, and alkyl sulphides. The SH frequency of 2575 cm.$^{-1}$ is lower than the CH and OH frequencies, and suggests a weak binding force and thus possibly explains the slightly polar properties of hydrogen sulphide and the mercaptans. A. C. M.

1514. Relative Intensities of Lines in Raman Spectra of Benzene-Toluene Mixtures. Elizabeth A. Crigler. *Am. Chem. Soc., J.* 54. *pp.* 4207–4217, *Nov.*, 1932.—5% change in the relative concentration of the benzene-toluene mixture can be determined by photometry of the 786 cm.$^{-1}$ line of toluene and the 849-cm.$^{-1}$ and 991-cm.$^{-1}$ lines of benzene. A. C. M.

1515. Deviations from the Sum Rule for Strontium. W. Kast. *Zeits. f. Physik*, 79. 11–12. *pp.* 731–735, *Dec.* 30, 1932.—The intensities of the $2^3P - 4^3D$ and $2^3P - 2^3P'$ for Sr. have been measured. A disturbance between the closely neighbouring 2^3P and 4^3D terms has been found, which results in a weakening of lines corresponding to P_1' and P_2' and a strengthening of those due to D_1 and D_2. **Errata,** *ibid.*, 80. 5–6. *p.* 414, *Jan.* 31, 1933. F. S.

1516. Raman Effect in Liquids. A. Carrelli and J. J. Went. *Zeits. f. Physik*, 80. 3–4. *pp.* 232–236, *Jan.* 23, 1933.—A study of certain phenomena in the spectrum of light scattered by benzol, water, carbon tetrachloride and glycerin. Attention is in particular given to the Rayleigh continuum. J. H. A.

1517. Raman Effect in Organic Sulphides and Some Thio-Compounds. V. N. Thatte and A. S. Ganesan. *Phil. Mag.* 15. *pp.* 51–64, *Jan.*, 1933.—The Raman spectra of ethyl, propyl, allyl, *iso*-butyl, and benzyl sulphides, and of *iso*-amyl hydrosulphide, thioglycollic acid, and thioacetic acid, are described. All show the lines at 1450, 2870, and 2930 cm.$^{-1}$ due to the C = H linkage, but these show characteristic variations from one compound to another. The 2870 cm.$^{-1}$ line occupies the same position in all the spectra except those of benzyl sulphide, in which it is absent, and allyl sulphide, in which it is replaced by the shift at 2918 cm.$^{-1}$. The frequencies attributable to the C.S.C. group in the sulphides are explicable on dynamical considerations if the molecule is assumed to be of the type SR_2, where R is the alkyl group. H. F. G.

1518. Raman Effect for Liquid and Solid Carbon Dioxide. J. C. McLennan and H. D. Smith. *Canad. J. of Research*, 7. *pp.* 551–555, *Dec.*, 1932.—Methods of obtaining clear specimens of liquid and solid CO_2 are described and also a new type of mercury arc. Raman spectra for these states are compared with that of the gaseous states, and it is concluded that there is no change in the molecule from — 92°C. to 20°C. This is the first substance examined in all these states. F. S.

1519. Mechanical Aid to Analysis of Complex Spectra. G. R. Harrison. *Rev. Sci. Instruments*, 3. *pp.* 753–759, *Dec.*, 1932.—This is a machine for recording automatically the wave-member intervals between each line and every other line within a desired range. Small holes are punched in a black paper tape which is passed back across a sheet of bromide paper moving in a direction at right angles. Lines having any given separation can be picked out on the resultant diagram by means of a straight edge. F. S.

1520. Apparatus for Spectroscopic Studies in the Intermediate Infra-Red Region—20–40μ. J. Strong. *Rev. Sci. Instruments,* 3. *pp.* 810–821, *Dec.,* 1932.—In the spectrometer employed for this region the whole optical path can be evacuated to 10^{-4}mm. mercury by using charcoal and liquid air; slits are regulated from outside the vacuum by a regulated head; the optical system is such that one and the same mirror can be used for collimating and telescoping the radiation; the prism (or grating) is rotated by a 10″ lever actuated by an ordinary micrometer; the spectrometer may be converted into a self-recording instrument; and maximum isolation of the thermopile is another essentially outstanding feature of the apparatus. The absorption cell has several unique characteristics: the window is small enough to handle a beam of numerical aperture 1/3; the radiation path in the gas is 1 metre; the cell is so constructed that it can be evacuated or subjected to pressures of several atmospheres; and it can be heated to 300°C. Sources of radiation—the Nernst glower, the Welsbach mantle, and the Globar radiator—are discussed as well as many interesting points of technique. W. R. A.

1521. Energy Distribution in Grating Spectra. U. Schmieschek and E. Spiller. *Zeits. f. techn. Physik,* 14. 1. *pp.* 33–36, 1932. *From the Reichsanstalt.*—In an earlier paper [see Abstract 2395 (1932)], a subjective method was described. In the present paper a photographic and a photoelectric method are described for the comparison of the behaviour of two gratings. Good agreement with the earlier results is found.
F. S.

1522. Large Aperture Spectrograph and Monochromator. O. Schönrock and C. Leiss. *Zeits. f. techn. Physik,* 14. 2. *pp.* 78–81, 1933.—In this instrument, lenses are replaced by a system of plane and concave mirrors. Slit and photographic plate are placed behind apertures cut at the centres of two plane mirrors disposed so that the light is collimated and focussed by concave mirrors used axially. For use in the ultra-violet, the mirrors are coated by the Hochheim process and a Cornu prism is used. When used as monochromator, the plate is replaced by a slit and the spectrum is passed across it by rotating the second concave mirror by means of a micrometer screw. The instrument described has an aperture ratio of 1 : 3·5 or 1 : 2·5, which can be increased to 1·7–1·6.
F. S.

See also Abstracts 1252, 1341, 1393, 1437, 1479, 1619, 1642, 1645.

X-RAYS.

1523. Monochromatic X-rays. H. Küstner. *Zeits. f. Physik,* 77. 1–2. *pp.* 52–59, *July* 19, 1932.—An improvement in the technique described in an earlier paper [see Abstract 3847 (1931)] in which the $K\alpha\alpha'$ doublet of an element is separated almost alone by the use of differential filters. A. C. M.

1524. Measurement of X-Ray Absorption Coefficients by the Use of the FP-54 Pliotron. L. M. Heil and J. E. Edwards. *Phys. Rev.* 43. *pp.* 1–4, *Jan.* 1, 1933.—The FP-54 pliotron has been used to measure the ionisation currents produced in the determination of X-ray absorption coefficients. When careful shielding was made and proper insulation provided it was found to be extremely stable in the measurement of currents of the order of magnitude 3×10^{-15} ampere. The X-ray absorption coefficients of Cu and Al were determined over a range from 0·25Å to 0·6Å. They were found to agree quite well with those obtained by other observers and led to a value of 2·7, in the wave-length range 0·25Å to 0·6Å, for the constant n in the absorption equation, $\mu/\rho = CN^4\lambda^n + \sigma/\rho$. AUTHORS.

1525. Absorption Curves and Spectra of X-Ray Beams. A. Mutscheller. *Radiology*, 20. *pp.* 32–41; *Disc.*, 41–46, *Jan.*, 1933.—At the 1928 International Congress of Radiology, as a measure of radiation quality, absorption in a known metal was adopted as a standard of absorption. At the 1931 International Congress the half-value filter thickness was adopted as a preferable standard. The present investigator is not in agreement. It is pointed out that the various methods of measuring and defining radiation quality are only different ways of interpreting absorption curves and the three various methods are discussed on this basis. The X-ray spectrum is considered from a theoretical aspect, and absorption is discussed in respect to intermittent sine curve and constant potential excitation of the X-ray tube. The author finds that pulsating h.t. current gives a practically complete, straight, semi-logarithmic absorption curve, whereas constant potential gives a bent semi-logarithmic absorption curve, the variation being due to the different spectral distributions of the wave-length intensities in the two cases. Pulsating current gives greater characteristic line intensity. The intensity of the shorter wave-length portion of the spectrum, is varied with increased filter thickness with constant potential, to a much greater extent than with pulsating voltage. The average wave-length has a direct meaning, when applied to radiation quality of depth actions, only if the semi-logarithmic absorption curve is a straight line. Suggestions are made regarding the interpretation of bent absorption curves. In the *Discussion*, **L. Taylor** drew attention to the difficulties of obtaining straight absorption curves under practical conditions of X-ray therapy and has failed to do so in his own practical work. **E. A. Pohle** likewise drew attention to practical difficulties and **R. R. Newell** to the fact that under practical conditions, when radiation is administered to the human body, absorption and scattering within the patient's body changes the composition of the radiation effective at a particular viscus. B. J. L.

1526. Effect of Particle Size upon Intensity in X-Ray Spectroscopic Analysis. G. R. Fonda. *Am. Chem. Soc., J.* 55. *pp.* 123–127, *Jan.*, 1933.—The intensity of a diffracted X-ray beam has been found to be decreased by surface irregularities of the target in proportion to their magnitude and to the coefficient of absorption of the target material for the wave-length involved. This effect has been studied for grids of various size and powdered particles of metals and compounds of varying diameter. For accuracy in quantitative chemical analysis based on X-ray spectroscopy attention must therefore be given to the fineness of the powdered samples, more especially when Lα radiation is used. F. J. W.

1527. Theory of X-Ray Absorption in Molecular Gases. Part II. H. Petersen. *Zeits. f. Physik*, 80. 3–4. *pp.* 258–266, *Jan.* 23, 1933.—In an earlier paper [see Abstract 4347 (1932)] the fine structure of the X-ray absorption in molecular gases is calculated using Born's collision theory to determine the elastic scattering of electrons by an atom. The

present paper shows that this application of Born's theory leads to very inaccurate results for the X-ray absorption near the main absorption edge. A method used by Faxén and Holtsmark [see Abstract 37 (1928)] in their interpretation of the effective atomic cross-sections in the Ramsauer effect gives an expression for the electron scattering which leads to a more accurate value for the X-ray absorption. The ratio of the X-ray absorption due to an atom in a molecule to that due to the free atom is calculated as a function of the energy of the electron ejected in the ionisation process. The theoretical values for chlorine are compared with the experimental results of Lindh and of Coster and Veldkamp.
J. E. R. C.

1528. X-Ray Tube Input Control. W. R. Harper. *Journ. Sci. Instruments,* 10. *pp.* 10–12, *Jan.,* 1933.—The requirements for maintaining a steady electrical input to a hot-kathode X-ray tube are discussed, with particular reference to the use of fluctuating a.c. mains. It is shown that the fluctuations cannot be counteracted by a control which is confined to the primary side of the h.t. transformer, owing to changes in wave-form introduced by the control itself. The correct methods of control are described. AUTHOR.

1529. X-Ray Study of Ferrous Oxide Solid Solutions. E. R. Jette and F. Foote. *J. Chem. Phys.* 1. *pp.* 29–36, *Jan.,* 1933.—Gives the results of an examination of a series of iron oxides with compositions between 76·08 and 76·72% iron. These come within the single phase, solid-solution area known as Wüstite. The lattice constants and densities of the individual members have been determined. The NaCl structure found by earlier investigators and considered by them to be the structure of FeO has been found throughout this series, but contrary to the earlier results, the size of the unit cell has been found to decrease as the iron content decreases. The solid solution is of a complex type ; an oxygen ion replaces an FeO group with an accompanying increase in valency. The results are discussed from chemical and structural points of view.
C. O. B.

1530. Correction of Errors of X-Ray Spectrometers. H. Seeman. *Zeits. f. Physik,* 79. 9–10. *pp.* 661–667, *Dec.* 15, 1932.—Corrections are calculated for use in conjunction with the author's spectrometer methods. The results are applicable to the spectrometers developed by Siegbahn. The position of the zero, the inclination of the reflecting plane to the photographic plate, and methods of interpolating an unknown line between reference lines, all of which are said to be involved when making precision measurements, are made the subject of a special article. J. E. R. C.

1531. Correction of Errors of X-Ray Spectrometers. M. Siegbahn. *Zeits. f. Physik,* 80. 5–6. *pp.* 413–414, *Jan.* 31, 1933.—Remarks upon the paper by Seeman [see preceding Abstract] and shows that the special calculations involved in interpolating between reference lines are unnecessary, since by a special procedure it is possible to obtain the unknown line twice on the same plate and thus to avoid the necessity for a reference line. J. E. R. C.

See also Abstracts 1451, 1649.

HEAT.

CALORIMETRY.

1532. Low Temperature Specific Heats. Part III. Molecular Rotation in Crystalline Primary Normal Amyl Ammonium Chloride. J. C. Southard, R. T. Milner and S. B. Hendricks. *J. Chem. Phys.* 1. *pp.* 95–102, *Jan.*, 1933.—The heat capacity of primary normal amyl ammonium chloride was measured between 20° and 280°K. When the product was quenched to 90°K. a metastable form was obtained which, upon heating above165°K., slowly changed towards an apparently stable form. Two regions of gradual transition were found, and X-ray powder diffraction photographs taken above and below the transition regions were remarkably similar. The experimental results are interpreted on the basis of rotation of the $NH_3C_5H_{11}^+$ groups in the crystals. H. H. Ho.

1533. Heat Capacity, Heat of Sublimation and Heat of Solution of Phosphorus Pentoxide. M. Frandsen. *Bureau of Standards, J. of Research*, 10. *pp.* 35–58, *Jan.*, 1933.—The heat capacity of P_2O_5 vapour between its sublimation temperature (358°C.) and 1100°C. is found calorimetrically to be $36 \cdot 8 \pm 1$ cal. per mole. For the metastable crystalline form the heat capacity is $22 \cdot 17 + 0 \cdot 07804\ t - 8 \cdot 45 \times 10^{-5}\ t^2$ cal. per mole per 1°C. between room-temperature and the sublimation point. From the two series of observations, the latent heat of sublimation is 8800 ± 1300 cal. per mole. The heat of solution of P_2O_5 in water at 25°C. to form metaphosphoric acid is 4200 ± 210 cal. per mole, whilst for the formation of orthophosphoric acid the value is 5440 ± 210 cal. per mole. J. H. A.

1534. Isothermal Calorimeter for Slow Reactions. E. D. Coon and F. Daniels. *J. Phys. Chem.* 37. *pp.* 1–12, *Jan.*, 1933.—The calorimeter has been designed especially for the study of chemical kinetics and biological processes. The heating effect is exactly counterbalanced by a cooling effect produced by evaporating carbon tetrachloride or other liquid in a regulated air stream, absorbing the vapour in silica gel, and weighing. The calorimeter is capable of measuring continuously reactions which evolve less than a calorie an hour. As examples of its use the heat of formation of yeast is found to be $130 \cdot 1$ cal./gm. of glucose consumed, and the hydrolysis of methyl acetate absorbs 1052 cal. per mole. T. B.

See also Abstract 1541.

CONDUCTION.

1535. Theory of Heat Conduction and Convection from Short Hot Vertical Cylinders. W. S. Kimball and L. D. Childs. *Phil. Mag.* 14. *pp.* 337-355, *Sept.*, 1932.—By means of the classical equations of hydrodynamics and conduction and the following two empirical laws, which were found previously to be applicable to low vertical hot planes, the authors draw a number of conclusions for short hot vertical cylinders. The laws in question are: (1) the locus of the maxima of the convection velocity curves is an isothermal surface (the film boundary) at a temperature half-way between the hot surface and the ambient air; (2) half the heat supply is convected up away inside this surface and half outside it. In the case of short hot vertical cylinders stream-line conditions prevail and the mechanism of heat transfer is pure conduction through gas in stream-line motion, as was the case for low vertical planes. It is found that: The heat-transfer from the hot cylinders is proportional to the five-fourths power of the temperature excess; the maximum convection velocity is proportional to the square root of the temperature excess, but independent of the pressure; the film-thickness varies inversely as the fourth root of the temperature excess and is notably smaller for cylinders of less than 6 cm. diameter; heat transfer coefficients are proportional to the square root of the pressure, the fourth root of the temperature excess, and increase markedly for cylinders of less than 6 cm. in diameter. The experimental data of Griffiths and Davis on heat transfer from cylinders under 40 cm. high and 17·4 cm. in diameter is checked to a satisfactory degree of accuracy. The experimental data seem to indicate that the relation $H = \frac{b}{a}(1 - e^{-aH})$, involving the initial height H = 40 cm., separating stream-line conditions below from turbulence above is independent of L, the cylinder height, for short cylinders as well as tall ones. H. L. B.

1536. Thermal Diffusivity of Zinc. R. H. Frazier. *Phys. Rev.* **43.** *pp.* 135–136, *Jan.* 15, 1933.—Results are given of tests to determine with precision the thermal diffusivity of a very pure sample of zinc. The over-all probable error is shown to be 0·13%. The method of test was presented in detail in a former paper [see Abstract 3809 (1932)]. AUTHOR.

CONVECTION.

See Abstract 1535.

DILATATION.

1537. Interference Method of Measuring Thermal Expansion. G. E. Merritt. *Bureau of Standards, J. of Research,* 10. *pp.* 59–76, *Jan.,* 1932.—Details are given of a method of determining thermal expansions by means of an interferometer consisting of two parallel quartz plates, the distance apart of which depends on the dimensions of the specimen under test. Measurements can be taken either with a steady or changing temperature by observing the movement of fringes produced when the plates are illuminated with monochromatic light. G. G. S.

See also Abstract 1541.

EVAPORATION.

1538. Maximum Rate of Evaporation of Water. T. Alty. *Phil. Mag.* 15. *pp.* 82–103, *Jan.,* 1933.—The rate of evaporation from the outer surface of water drops has been measured under different low pressures, the temperature of the actual surface layer being deduced from surface-tension measurements. The results show only about 1/25 of the theoretical rate of evaporation, implying that only this fraction of the molecules striking the surface are able to remain there. J. H. A.

MELTING AND BOILING POINTS.

1539. Melting Point Depressions of Borneol and Camphoroxime. T. S. Patterson, Janet H. Blackwood, and J. McW. Stewart. *Chem. Soc., J. pp.* 93–95, *Jan.,* 1933.—The object was to examine the suitability of various substances for use as solvents in cryoscopic work.

With r-iso borneol, two solutes (hexa-acetyl mannitol and acetanilide) were tried. The depression is proportional to concentration at least up to 10 moles of solute per 100 moles of solvent. For laevo-borneol, the depressions are linear to an even higher concentration ; six different solutes in varying concentration all lie on the same line. With dextro-camphoroxime, the melting point curve shows practically no straight portion. The melting point depression when bornyl methylxanthate is used as solvent is very small. J. H. A.

See also Abstract 1260.

TEMPERATURE, MEASUREMENT OF.

1540. Dependence of Thermometer Lag on the Viscosity of the Indicating Liquid. W. Grundmann. *Phys. Zeits.* 34. *pp.* 75–77, *Jan.* 15, 1933.—Describes experiments with thermometers filled with various liquids (*e.g.*, creosote and pentane), which indicate that the thermometer lag depends on the viscosity of the indicating liquid. G. G. S.

See also Abstract 1328.

THERMOCHEMISTRY.

1541. Some Physical-Chemical Constants of Dioxan. W. A. Roth and Ingrid Meyer. *Zeits. f. Elektrochem.* 39. *pp.* 35–37, *Jan.*, 1933.—The following data are recorded : Heat of fusion, $-33\cdot8_3$ cal/gm.; heat of combustion, 6370 ∓ 10 cal/gm.; density between 13 and 25° C., $d_t = 1\cdot05565\,(1 - 0\cdot001063t)$, expansion coefficient, $0\cdot00109_4$ between 13° and 25°. H. H. Ho.

1542. Energy Transfer between Complex Gas Molecules and Solid Surfaces. E. W. R. Steacie and H. A. Reeve. *Roy. Soc. Canada, Trans.* 26. *pp.* 75–86, *May*, 1932.—A number of homogeneous unimolecular decomposition reactions have been investigated on heated platinum filaments, when it was found that the reactions invariably take place in the gas layer surrounding the filament and are not catalysed. In the case of ethyl ether and of acetone, the gas layer is in thermal equilibrium with the filament, and the apparent heat of activation calculated from the temperature coefficient of the reaction agrees with that of the homogeneous reaction. With propionaldehyde and with methyl ether, the apparent heat of activation is much higher than that of the homogeneous reaction. An examination of the molecular statistics of these reactions shows that they also take place in the layer of gas surrounding the filament. The high temperature coefficients of these reactions can be explained on the assumption that the accommodation coefficients for these gases are low, and hence thermal equilibrium with the filament is not attained by colliding gas molecules.

H. H. Ho.

1543. Explosions of Hydrogen-Air and Carbonic Oxide-Air Mixtures at Initial Pressures up to 1,000 Atmospheres. W. A. Bone, D. M. Newitt, and D. T. A. Townend. *Roy. Soc., Proc.* 139. *pp.* 57–74, *Jan.* 2, 1933.—In previous papers of this series the important discovery was made of N_2-activation in $CO - O_2 - N_2$ explosions at high initial pressures due to absorption by N_2 molecules of the radiation emitted by the burning carbonic oxide. The activated nitrogen then reacts with the excess of oxygen to produce large quantities of nitric oxide. In view of the theoretical importance of these experiments and their bearing on problems of nitrogen fixation, a new bomb has been designed and made to withstand pressures up to 10,000 atmospheres. Explosions of $2H_2 + O_2 + 3{\cdot}76N_2$, $2CO + O_2 + 3{\cdot}76\,CO$, and $2CO + O_2 + 3{\cdot}76N_2$ mixtures have been carried out in this bomb at initial pressures up to 500 atmospheres in the first and second, and up to 1,000 atmospheres in the third case. Complete pressure-time records are obtained and exhibited in tables and curves. T. B.

1544. Formation of Nitric Oxide in Carbonic Oxide-Oxygen-Nitrogen Explosions. D. T. A. Townend and L. E. Outridge. *Roy. Soc., Proc.* 139. *pp.* 74–83, *Jan.* 2, 1933.—The secondary formation of nitric oxide in $CO - O_2 - N_2$ explosions in excess of oxygen rapidly increases with the density of the medium, and its rate of decomposition is much less than its rate of formation, so that the faster the cooling after the explosion the greater the chance of oxides of nitrogen surviving in the cold products. In the experiments now described therefore, the normal cooling down of the explosion products has been accelerated in a series of experiments at selected high initial pressures. The explosion chamber is separated from a much larger " expansion chamber " by a disc of such strength that it will burst at a given high pressure. The effect of such release, as proved by the pressure-time record, is to cool the hot products down to room-temperature in less than 0·005 sec. The largest NO_2 yield, in a mixture $2CO + 3O_2 + 2N_2$, at an initial pressure of 88 atmospheres, is 5·1%. The experimental results as a whole afford further strong support for the view that there is a primary N_2 activation followed by a secondary NO formation. [See preceding Abstract.] T. B.

1545. Nitric Oxide Formation in Continuous High-Pressure Flames of Carbonic Oxide in Oxygen-Nitrogen Atmospheres. D. M. Newitt and F. G. Lamont. *Roy. Soc., Proc.* 139. *pp.* 83–93, *Jan.* 2, 1933.—This is a systematic study of nitric oxide formation in steady flames of carbonic oxide continuously maintained at high pressures in atmospheres of oxygen and nitrogen in various pre-determined proportions. Haber and Coates in similar experiments concluded that little benefit results from increasing the pressure beyond about 13 atmospheres, but the present experiments show a marked beneficial effect upon NO formation by an increase in pressure from 10 to 100 atmospheres. Four principal series of experiments are described with carbonic oxide flames burning in atmospheres of 70 $O_2/30\ N_2$, 50 $O_2/50\ N_2$ ("Linde-air"), 33·3 $O_2/66{\cdot}7N_2$, and " ordinary air." The results show the favourable influence of pressure on NO formation in CO flames in $O_2 - N_2$ atmospheres, and demonstrate its dependence more upon the N_2/CO_2 ratio than mere temperature of the flame. They also bear out generally the views expressed in the two previous papers regarding N_2 activation. T. B.

1546. Critical Ignition of Explosive Hydrogen Mixtures. J. H. Maas and C. Ewing. *J. Phys. Chem.* 37. *pp.* 13–15, *Jan.*, 1933. —It was observed by Thornton [see Abstract 82 (1915)] that the least spark energy required to ignite an explosive mixture of a gas in air varies discontinuously as the composition of the gas is changed continuously. In the present paper this " stepped " or " critical " ignition is shown to depend on the presence of nitrogen in the gas mixtures considered. For example the ignition curve for hydrogen in air mixtures has two distinct steps, while smooth curves are found for mixtures of hydrogen and oxygen, and also for mixtures of hydrogen, argon and oxygen where the argon is present in the same proportion as nitrogen in the air mixtures. T. B.

1547. Rates of Detonation in Carbon Monoxide-Oxygen Mixtures. C. Campbell, C. Whitworth and D. W. Woodhead. *Chem. Soc., J. pp.* 59–62, *Jan.,* 1933.—Measurements of rates of detonation in carbon monoxide-oxygen mixtures have been made, the method of initiation being that of introducing and firing a small amount of electrolytic gas or similar mixture around the spark gap. The flames are photographed on a drum camera. Plotting the mean values against their compositions, the curve indicates an almost linear increase in velocity from 1710 m./sec. for the mixture containing 50% to 1770 m./sec. for that containing 80% carbon monoxide. No sharp peak is disclosed by the curve at 75°C. as observed in similar experiments by Bone and Fraser [see Abstract 2492 (1931)], but, as with hydrogen-oxygen mixtures, the speed appears to be determined mainly by the calorific value and density of the mixture. T. B.

1548. Influence of Ionisation upon the Ignition Temperature of a Gas Mixture. B. Lewis and C. D. Kreutz. *J. Chem. Phys.* 1. *pp.* 89–94, *Jan.,* 1933.—An apparatus is described in which the influence of adding an ionised gas to a combustible gas mixture which is at a known high temperaure can be studied. The ionised gases which were used were obtained by passing nitrogen, helium, argon, or oxygen through a heavy spark discharge. The ignition temperature of the mixture was determined with and without the ionised gas and a marked depression is found to be produced by the ions. By a series of experiments it is shown that the effect is almost certainly due to the ions and it is suggested that the process by which this occurs is for the ionised gas atoms to ionise atoms of one of the combustible gases by inelastic collisions. This view is supported by the fact that the ionised gases had ionisation potentials greater than that of the methane which was one of the constituents of the combustible gas mixture. J. E. R. C.

1549. Thermal Decomposition of Ethyl Mercaptan and Ethyl Sulphide. N. R. Trenner and H. A. Taylor. *J. Chem. Phys.* 1. *pp.* 77–88, *Jan.,* 1933.—The thermal decomposition of ethyl mercaptan and ethyl sulphide was studied by a static method, and the reactions were shown to proceed homogeneously in glass vessels which had become poisoned by the products of the reaction. The decompositions showed a marked parallelism, and involved the same intermediate and proceeded to the same equilibrium. The intermediate was isolated and shown to possess the properties of a mercaptan but with physical characteristics different from any so far described. The intermediate decomposed unimolecularly with an energy of activation of about 40,000 calories at a rate somewhat less than the rate of its formation from ethyl sulphide and hydrogen sulphide. F. J. B.

See also Abstracts 1349, 1410, 1463, 1533, 1534, 1555.

THERMODYNAMICS.

1550. Empirical Equation of State. H. S. Frank and F. S. Lei. *Phys. Rev.* 42. *pp.* 893–899, *Dec.* 15, 1932.—The equation found to hold for ether and for carbon dioxide as gases or as highly compressed liquids, is $P = (RT/V)e^{a/V^b} - \phi$, where ϕ is a function only of V the volume, P is the pressure, T the absolute temperature and *a*, *b* are constants for the substance. For ether ϕ is $3834/V^{1\cdot892} - 6295/V^{7\cdot94}$. The equation does not hold so well in the intermediate ranges where the liquid is not compressed, or where the gas is highly compressed. J. H. A.

1551. Physico-Chemical Factors in High-Pressure Design. B. F. Dodge. *Indust. and Engin. Chem.* 24. *pp.* 1353–1363, *Dec.*, 1932.—A number of charts are given in which the compressibility factor of gases and vapours, PV/RT, is plotted against reduced pressure (ratio of actual to critical pressure) for a series of reduced temperatures (ratio of actual to critical temperature). These are employed as a basis for discussing deviations from the ideal gas law. Although the theory of corresponding states is only approximately true, since it depends on the validity of a three-constant equation of state, such as that of van der Waals, it is possible to estimate gas volumes approximately in the absence of actual compressibility data. For ethylene, the estimated compressibility factors agree well with the observed values. The P-V-T relationships of actual gases may be accurately and conveniently represented graphically on charts similar to the above, but giving the compressibility factor C for any one gas as a function of the pressure along a series of isotherms. C is defined either by the equation $C = PV/RT$ or as the ratio of the actual to the ideal volume at given P and T. The compressibility factor also offers the simplest means of making practical use of the P-V-T data for the calculation of gas densities and related quantities, but it is often desirable to express such data in the form of an equation of state. If the data are meagre, such an equation allows of interpolation and, to some extent, of extrapolation. These equations are useful especially when various thermodynamic quantities such as specific heat, heat content, or entropy are to be calculated from P-V-T data. From a practical standpoint, equations of state give explicitly either (1) the pressure, or (2) the volume. Most are of type (1), but type (2) is the more useful, as calculation of the gas volume or density is usually required and as the various general thermodynamic relations in terms of the pressure and temperature as independent variables are the more readily integrated. Of the large number of equations of state which have been proposed, a few are discussed. The van der Waals equation will be reasonably correct if the volume is well above the critical volume, and, if the temperature is well above the critical value, it may be used for somewhat smaller volumes. The Dieterici equation is no better than, and often not as good as, that of van der Waals, and the same is true of the Berthelot equation. Two of the most successful equations are those of Keyes and Beattie-Bridgeman, which are briefly considered. For gaseous mixtures neither the additive pressure nor the additive volume is, in general, correct, and which is the better approximation depends on conditions. Usually, however, deviations from the laws of additive pressures and volumes are much less than those of the ideal volumes of pure gases from the true volumes, so that the use of good equations of state or compressibility factors for pure gases and the laws of additive volumes or pressures will mostly result in fair approximation. As regards the specific heat of gases at high pressures, it is shown that C_P as a function of pressure may be calculated, with sufficient accuracy for practical purposes, from compressibility data, and that this method has advantages over direct determination. Virtually no experimental data on the specific heats of gas mixtures are available, but these too may be calculated with fair approximation. T. H. P.

1552. Heat of Expansion of a Gas of Varying Mass. L. J. Gillespie and J. R. Coe, Jr. *J. Chem. Phys.* 1. *pp.* 103–113, *Jan.*, 1933.—Equations are given for the direct treatment of experiments in which not only heat, but also masses pass the boundary of the container of the system during the experiment. The theoretical development is correlated with the treatment of Gibbs and certain difficulties in the physical interpretation of his equations are removed. It was found possible within a reasonable time to cause a gas to expand slowly enough from a calorimeter to simulate a reversible expansion, and the special equation developed for the heat of expansion with the aid of the Beattie-Bridgeman equation of state was verified by the results for the slow expansion of CO_2 and NH_3. A series of expansions of CO_2 was carried out at varying rates of flow. The results correlated by means of an empirical relation show that the results of the slow expansions correspond practically to an infinitely slow expansion. They also indicate that the heat effect for an infinitely rapid expansion is not zero for a real gas but possibly vanishes with the pressure. The bearing of the results on variable-pressure calorimetry as practised in experiments on the heat of adsorption is briefly discussed. J. J. S.

1553. Asymptotic Expansions of the Expressions for the Partition Function and the Rotational Specific Heat of a Rigid Polyatomic Molecule for High Temperatures. Irene E. Viney. *Cambridge Phil. Soc., Proc.* 29. *pp.* 142–148, *Jan.* 31, 1933.—By repeated application of the Euler-Maclaurin summation formula, the asymptotic expansions of the partition function and the rotational specific heat of a polyatomic molecule on the symmetrical top model are obtained. G. G. S.

1554. Heat Capacity Curves of the Simpler Gases. Part I. Gaseous Nitric Oxide. Part II. Gaseous Oxygen. H. L. Johnston and A. T. Chapman. *Am. Chem. Soc., J.* 55. *pp.* 153–192, *Jan.*, 1933.—Theoretical. The values of the heat capacity, entropy and free energy from near absolute zero to 5000°K. are calculated from spectroscopic data. A. S. C. L.

1555. Dissociation of Oxygen to 5000° K. Free Energy of Atomic Oxygen. H. L. Johnston and Margery K. Walker. *Am. Chem. Soc., J.* 55. *pp.* 187–193, *Jan.*, 1933.—The dissociation constants of oxygen are calculated, the heat of dissociation being obtained from spectroscopic data. A. S. C. L.

1556. Extension of the Phase Rule for Adsorption under Equilibrium and Non-Equilibrium Conditions. I. Langmuir. *J. Chem. Phys.* 1. *pp.* 3–12, *Jan.*, 1933.—Surfaces, such as a well-aged tungsten filament, are to be regarded as homogeneous except for a very small fraction of the area which is made up of the more active spots. For the extension of the phase rule, the term " field " is applied to the homogeneous parts of a surface on which adsorption can occur, a two-dimensional phase. A "surface phase " is a homogeneous layer upon a " field," usually, but not necessarily, a monolayer. A surface phase has C + E + 1 degrees of freedom ; where C is the number of components in the usual sense and E is the degree of freedom corresponding to the application of an external electric force. If this is constant, E = O. This surface phase postulate applies to a system not in equilibrium if the duration of transient states is large compared with the time taken for relaxation of the surface phase to surface homogeneity. The example of caesium vapour on a tungsten filament in an electric field is given, and the condition for a phase boundary is deduced. For equilibrium between P_v volume phases and P_s surface phases in S fields, the number of degrees of freedom, F_0, is $C + S - P_v - P_s + 2$; which is the ordinary phase rule when $S = P_s = O$. The types of non-equilibrium state are discussed. The degrees of freedom of such a system are $F_0 + \Delta F$, where ΔF is the additional number of degrees of freedom corresponding to those equilibrium conditions not fulfilled. To maintain this as a steady state, ΔF independent exterior power sources are needed. An example is given of surface mobility to show that, if it is large compared with the crystal size of the field, the active and non-active parts of the surface behave as a single phase. The condition for the development of two phases is that $4\pi^2 D/b^2 < d\nu/d\sigma$, where D is the diffusion constant, b the width of sections of one phase, ν the rate of evaporation, and σ the surface concentration of atoms. A. S. C. L.

1557. Thermodynamic Data on Zinc Chloride and Cadmium Chloride. F. Ishikawa, G. Kimura and T. Murooka. *Tohoku Univ., Sci. Reports,* 21. *pp.* 455–473, *Dec.,* 1932. *In English.*—Thermodynamic calculations concerning zinc and cadmium chlorides are made in order to determine the standard free energy change and the heat content change involved in the formation of these chlorides. From the results obtained, the entropies of the chlorides are calculated. The calculations are based on measurements of (1) the e.m.f. of a reversible cell of the type $Zn(Hg)/ZnCl_2(s)$, satd. solution, $HgCl/Hg$ over the temperature range 25 — 42·5°, the solid phase being the anhydrous chloride and (2) the vapour pressures of the hydrates and of the saturated solutions. The entropy values obtained are : $S_{HgCl} = 24{\cdot}1$ (25°) ; $S_{ZnCl_2} = 29{\cdot}6$ (25°) and $S_{CdCl_2} = 31{\cdot}2$ (25°). T. H. P.

1558. Thermodynamic Study of Cadmium Hydroxide. F. Ishikawa and E. Shibata. *Tohoku Univ., Sci. Reports,* 21. *pp.* 499–510, *Dec.,* 1932. *In English.*—The activity product of cadmium hydroxide has been determined by three different methods, the most reliable result being obtained by measuring the e.m.f. of the reversible cell $Cd(Hg)/Cd(OH)_2$, *N*-NaOH, HgO/Hg. The approximate solubility of the hydroxide has been determined by a potentiometric titration. The following free energy data have been derived : $Cd(s) + H_2$ (1 atmos.) $+ O_2$ (1 atmos.) $= Cd(OH)_2$ (s), $\Delta F_{298^\circ} = -1124_{69}$ cal. ; $Cd(s) + HgO(s) + H_2O(l) = Cd(OH)_2(s) + Hg(l)$, $\Delta F_{298^\circ} = -42100$ cal. ; $Cd(OH)_2(s) + H_2$ (1 atmos.) $= Cd(s) + 2H_2O(l)$, $\Delta F_{298^\circ} = -949$ cal.

T. H. P.

1559. Thermodynamics of Adsorption at the Surface of Solutions. E. A. Guggenheim and N. K. Adam. *Roy. Soc., Proc.* 139. *pp.* 218–236, *Jan.,* 1933.—The convention commonly used in fixing Gibbs' geometrical dividing surface, in which the surface excess of one of the components is arbitrarily taken as zero, is ill adapted to forming

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19

a physical picture of the structure of the surface. Several other conventions have been examined and the relations between the values of the surface excess obtained on the various conventions are derived from Gibbs' general equations and formulæ are given for calculating each one of them. The structure of the surface of water-alcohol solutions is investigated. The assumption that the only part of the liquid which is non-homogeneous is a unimolecular leads to reasonable results. F. J. W.

1560. Entropy of Polyatomic Molecules and the Symmetry Number. J. E. Mayer, S. Brunauer and Maria G. Mayer. *Am. Chem. Soc., J.* 55. *pp.* 37–53, *Jan.*, 1933.—It has been shown that any molecule will have among the additive terms in the entropy expression: $R\log_e\sigma$, with σ the symmetry number; $R\log_e (2S_i + 1)$ for every atom i of spin S_i; $R\log_e I$, with I the number of distinguishable optical isomers present in the gas. The quantum mechanical wave functions and the energy values of an ethane-like molecule have been calculated under the assumption of free independent rotation of the two CH_3 groups about the C – C bond. The entropy of this type of molecule has also been calculated. Convenient expressions have been given for the molal entropy of diatomic, rigid linear and non-linear polyatomic, and ethane-like molecules. The data necessary for entropy evaluations have been reviewed, and the accuracy which can be expected has been briefly discussed. The practical molar entropies (neglecting nuclear spin which cancels in all chemical reactions) of ethane, acetylene and benzene gases at 1 atm., 298°K., have been calculated to be 55·5, 47·2 and 65·1 E.U. respectively. H. H. Ho.

1561. Joule-Thomson Effect in Helium. J. R. Roebuck and H. Osterberg. *Phys. Rev.* 43. *pp.* 60–69, *Jan.* 1, 1933.—A description is given of changes in the apparatus previously used in the measurement of the porous plug coefficient, μ, for air. The effect of air as an impurity in helium was found to be quite negligible even at 10% of air, but increased rapidly thereafter. An experimental study of μ in mixtures of N_2 and He is desirable. The helium was purified by contact with activated charcoal at liquid air temperatures. In the range $-190°$ to 300°C. and from 1 to 200 atmospheres μ for helium was found to be negative and independent of pressure except at the lowest temperatures. It is small both in magnitude and variation. Significant trends of μ at the two temperature extremes were observed. A discussion of theory is to follow. [See also Abstract 207 (1931).] J. J. S.

1562. Rapid Derivation of Thermodynamical Relations. A. N. Shaw. *Roy. Soc. Canada, Trans.* 26. *pp.* 187–204, *May*, 1932.—The relations concerned are those between any of the quantities (pressure, volume, temperature, free energy, internal energy, etc.) which may be taken as variables, and their first and second derivatives with respect to two of the variables chosen as independent variables for the particular problem. The method as applied to first derivatives depends primarily on the use of the analytical theorem $(\partial x/\partial y)_s = (A_x B_s - A_s B_x)/(A_y B_s - A_s B_y)$ for which a mnemonic is that after writing $\left(\frac{AB - AB}{AB - AB}\right)$, the constant quantity is written as a subscript to each of the four symbols in the central block, the upper symbol in the derivative is written against the remaining quantities in the upper line, and similarly for the lower line. The notation is that $A_r = (\partial r/\partial \alpha)_\beta$, if r is a function of the variables

α and β. When second derivatives are involved, a somewhat similar procedure is available. J. H. A.

See also Abstracts 1305, 1626.

VAPOUR PRESSURE.

1563. Vapour Pressure of Hydrogen Rich in its Heavy Isotope. W. Meissner and K. Steiner. *Zeits. f. Physik*, 79. 9–10. *pp.* 601–612, *Dec.* 15, 1932. *From the Reichsanstalt.*—The vapour pressure of hydrogen containing more than the usual proportion of the isotope of mass 2 has been compared with that of ordinary hydrogen by means of a differential manometer. Observations were taken at the triple point and at the normal boiling point. The enriched hydrogen has the lower vapour pressure, which continues to decrease with the passage of time. J. H. A.

1564. Distribution Coefficient of Hydrogen Cyanide and Water over the Binary System (H_2O – HCN) at 18° C. K. Fredenhagen and Marianne Wellmann. *Zeits. f. phys. Chem.* 162. *Abt. A.* 6. *pp.* 467–470, *Dec.*, 1932.—Defining the distribution coefficient L as (HCN concentration in liquid phase) / (HCN concentration in gas phase), and making use of the partial pressure measurements of Bredig and Shirado, the authors calculate and plot the values of L against the concentration of HCN and water. In order to compare results with the authors' work on acetic acid and hydrofluoric acid it was necessary to know the distribution coefficient for much smaller values of the concentration of HCN, *i.e.*, less than 3%. They attempted to find this by the "flow-through" method. This proved futile, as it was found that the quantity of HCN carried from the gas phase depended on the velocity of flow of the gas. Further, the quantity of HCN absorbed after the passage of gas was much smaller than the loss of HCN in the saturation tubes. This indicated a reaction between the HCN and water vapour in the gas phase, probably $HCN + 2H_2O \rightleftarrows H.COOH + NH_3$. Bredig and Shirado's results are further discussed, and suggestions are made for future work. T. B.

1565. System Ethyl Alcohol—*n*-Heptane at 30° C. J. B. Ferguson, M. Freed and A. C. Morris. *J. Phys. Chem.* 37. *pp.* 87–91, *Jan.*, 1933.—For certain solutions Smyth and Engel [see Abstract 706 (1930)] observed that the partial pressure of the alcohol present exceeded the vapour pressure of pure alcohol at the same temperature. If the system alcohol-*n*-heptane is a true binary system of the components, the results should agree with the Duhem-Margules equation within the limits set by the deviations of the vapour from the laws of perfect gaseous solutions, and this agreement should be independent of the complexity of the liquid phase. Determination of the compositions of the co-existent phases of this system at 30° C, and measurement of the total pressures and calculation of the partial pressures fail to support the anomalous observations of Smyth and Engel. T. H. P.

1566. System Ammonia-Water at Temperatures up to 150° C. and Pressures up to Twenty Atmospheres. I. L. Clifford and E. Hunter. *J. Phys. Chem.* 37. *pp.* 101–118, *Jan.*, 1933.—A dynamic method has been used to determine vapour compositions between 60° and 100° C and for pressures up to 1·5 atmospheres, a static method being found necessary for the higher range of temperature and pressure. The compositions of the vapours in equilibrium with ammonia-water solutions have been determined (1) at 60°, 80°, 90° and 100° C. for solutions with total vapour pressures up to 1·5 atmospheres and (2) over the range 100–150° C. and 1–20 atmospheres. From the results obtained, the isotherms for temperature intervals between 60° and 150° C. have been constructed. Making use of the results of Perman (*Chem. Soc., J.* 83. *p.* 1168, 1903), Mollier [see Abstract 2059 (1908)] and Smits and Postma (*Akad. Sci. Amsterdam, Proc.* 17. 1. *p.* 182, 1914), the isobars for 10, 8, 6, 4, 2, 1, 0·5, 0·2, and 0·02 atmospheres have been obtained. T. H. P.

1567. Vapour-Pressure Measurements of BaO, SrO, CaO and their Mixtures. A. Claassen and C. F. Veenemans. *Zeits. f. Physik*, 80. 5–6. *pp.* 342–351, *Jan.* 31, 1933.—The vapour pressures were determined from the weight of salt evaporated in a given time, the temperature of the emitting surface being measured with a pyrometer. For BaO the formula for the vapour pressure obtained in the measurements is the following :—

$$\log p \text{ (in mm. Hg)} = -1{\cdot}97\,\frac{10^4}{T} + 8{\cdot}87$$

for the temperature range 1200° – 1500° K. Similar formulæ were obtained for SrO and CaO. Some measurements were made with mixtures but only the amount of BaO evaporated could be determined. The results lead to speculations as to the mixibility of the BaO and SrO (CaO). W. S. S.

1568. X-Ray Study of the Changes in BaO – SrO Mixtures on Glowing. W. G. Burgers. *Zeits. f. Physik*, 80. 5–6. *pp.* 352–360, *Jan.* 31, 1933.—Vapour-pressure measurements [see preceding Abstract] suggest that BaO and SrO form mixed crystals on glowing. X-ray photographs (Debye-Scherrer) were taken of mixtures of BaO and SrO before and after glowing at various temperatures for known periods. The photographs establish that mixed crystals are actually formed with a linear variation of the lattice constant with composition proportions. W. S. S.

1569. Production of Merget's Phenomenon by Arsonvalisation with Short Waves. H. Bordier. *Comptes Rendus*, 196. *pp.* 255–257, *Jan.* 23, 1933.—Merget's phenomenon of thermodiffusion—the drawing in of gas into a porous body when moisture contained therein is evaporated therefrom—has been investigated in a new way. A porous vessel filled with powdered brick with a tube penetrating to its centre and closely encased with cardboard is heated to 70–80° by h.f. electric waves. If the vessel and its contents are quite dry no air escapes through the pipe, but if moistened with water air escapes in increasing amount and for a longer period the more moisture present. Similar results are obtained if the brick, etc., is moistened with methyl or ethyl alcohol or ether, the amount of air evolved increasing with the volatility of the liquid. C. A. S.

ACOUSTICS.

1570. Propagation of Sound Waves of Finite Amplitude. Y. Rocard. *Comptes Rendus,* 196. *pp.* 161–164, *Jan.* 16, 1933.—Considers the necessity of taking into account the finite amplitude of sound waves under certain conditions. The equation of propagation of waves of finite amplitude passing along an exponential horn is soluble. G. G. S.

1571. Dispersion of Sound in Nitrogen Tetroxide. W. T. Richards and J. A. Reid. *J. Chem. Phys.* 1. *pp.* 114–128, *Jan.,* 1933.—Several types of sound dispersion in a dissociating gas are discussed. Einstein's expression for the velocity of sound in a dissociating gas has been modified to include heat-capacity dispersion. Accounts are given of measurements on the velocity of sound in nitrogen tetroxide. The range of temperature studied is 0° to 30° C., the range of pressure 132mm. to 670mm., and the range of frequency 9kc. to 451kc. The velocity of sound has been thus defined with an estimated error of $\pm 0\cdot 1$ m. sec.$^{-1}$. The maximum dispersion observed is about 5 m. sec.$^{-1}$. Hence the rate constant of the dissociation reaction is $4\cdot 8 \times 10^{4} \pm 0\cdot 5 \times 10^{4}$ at 25° C. and 260 mm. The activation energy obtained for the dissociation reaction is $13\cdot 9 \pm 0\cdot 9$ k.cal. An upper limit for the heat capacity of nitrogen tetroxide being fixed by experiment, the effective molecular diameters for the activation process must be at least three times those for ordinary kinetic collisions. J. J. S.

1572. Absorption and Diffusion of Ultrasonic Energy. E. Paolini. *Alta Frequenza,* 1. *pp.* 357–375, *Sept.,* 1932.—The emitter of ultrasonic energy is a silvered quartz plate maintained in piezoeletric vibration by an alternating frequency of 267 kc. and the receiver is a radiometer such as was used by Dvorak and by Poynting and Barlow for discovering radiant energy. The law of absorption $p = p_0 e^{-kx}$, is verified where p_0 is the pressure near the quartz, p the pressure near the radiometer, x is the distance in cm. and k is the coefficient of absorption in cm.$^{-1}$. Propagation is limited to the solid angle $0\cdot 37\pi^2\lambda_r^2$. Solid walls diffuse ultrasonic energy in proportion to their roughness, and reflect it regularly if perfectly smooth. E. E. F. d'A.

1573. Optical Method of Determining Absorption of Ultrasonic Waves by Liquids. P. Biquard. *Comptes Rendus,* 196. *pp.* 257–259, *Jan.* 23, 1933.—An arrangement is described for determining the relation between the intensity of the supersonic waves and the amount of diffracted light, and curves deduced relating the ratio I/I_0 (I being the intensity of the light passing through the liquid subjected to the supersonic waves, and I_0 that passing in the absence of such waves) to the power emitted by the piezoelectric quartz when the light passes at varying distances, x, from the quartz. I/I_0 decreases linearly with increase in power, and exponentially with increase in x. [See Abstracts 4457, 4458 (1932).] C. A. S.

1574. Sound Field in the Neighbourhood of an Absorbent. G. v. Békésy. *Zeits. f. techn. Physik,* 14. 1. *pp.* 6–10, 1933.—Several illustrations are given of the fact that the intensity of a sound is decreased by the presence of an absorbent. An experiment with water waves is used to illustrate this point, and after considering the analogous case of the propagation of electromagnetic waves over a semi-conductor such as the earth the author proceeds to describe an experiment with sound waves. Sound from a loud-speaker is directed towards a microphone and on its way passes over an absorbent surface. It is shown that there is a minimum of sound intensity near the absorbent surface and that there is also a reduction of intensity by an amount varying with the height for points at a good distance (up to 75 cm.) above the surface. The effect at a distance decreases with decrease of wave-length. The relevance of this effect to building acoustics is discussed. J. E. R. C.

1575. Sounds Emitted by Model Airscrews. J. Obata, S. Morita, and Y. Yosida. *Phys. Math. Soc., Japan, Proc.* 14 *pp.* 486–508, *Oct.*, 1932. *In English.*—This paper is a sequel to a previous paper [see Abstracts 318 and 319 (1933)]. Models of five different two-bladed airscrews were used and the sound was picked up by a condenser microphone, amplified, and recorded by an oscillograph. The intensity of the sound emitted, in decibels, is found to bear a linear relationship to the rotational speed of the airscrew while the relation between the pitch angle and the amplitude of the emitted sound is given as $\log a = \mathrm{A}n + \mathrm{B}e^{a\theta} + \mathrm{C}$, where a is the amplitude of the sound, n is the rotational speed, and θ is the pitch angle. Numerical values of the constants are given. The polar diagrams which are given are liable to error since the experiments were conducted with the airscrew in close proximity to a wall and to the ground. For one type of airscrew models were made to two different scales and it is found that for the same tip speed the smaller airscrew produces the less noise. The high pitched component of the sound is found to predominate at low rotational speeds, but at high speeds the low pitched component may have the greater intensity. Sounds due to elastic vibrations are detected in some cases. A number of oscillograms and their analyses accompany the apper. J. E. R. C.

1576. Aural Localisation of Various Sounds. M. Reich and H. Behrens. *Zeits. f. techn. Physik*, 14. 1. *pp.* 1–6, 1933.—The results of an experimental investigation upon the localisation of sound of different types by a number of people are given. Both pure and impure tones were employed, the latter being produced by the mixing of tones of known frequency. The sounds were produced either from telephone earpieces or thermophones and the sources of sound being located in separate tubes, it was possible to vary the relative lengths of the paths traversed by the two sounds. The effects of varying the frequency, the path difference, the intensity and the quality of the tones was investigated and the following results obtained. (1) Localisation is most certain when using sounds of frequency between 400 and 800 ∼. For frequencies below this the apparent direction rotates gradually from that of the median plane to a direction at right angles but moves no further as the path is increased. (2) With decreasing intensity localisation becomes less certain. (3) Increasing path difference increases the uncertainty. (4) More precise observations are possible with impure tones than with pure tones. (5) With anharmonic mixtures of tones it is possible, with certain path differences, for the two tones to occupy different apparent positions. J. E. R. C.

See also Abstracts 1387, 1406, 1458.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

1577. Extension of the Methods of Heaviside's Calculus in the Calculation of [Electrical] Circuits Containing Parameters Varying with Time. J. Neufeld. *Phil. Mag.* 15. *pp.* 170–177, *Jan.*, 1933.—The methods of Heaviside's operational calculus are applied to deriving the value of the current resulting from the application of an e.m.f., varying according to the law E(t), to an electrical circuit the parameters of which vary explicitly with time, the variation being effected in a manner equivalent to the continuous insertion of infinitesimal increments of admittance in parallel in the circuit. J. S. G. T.

See also Abstract 1659.

CONDUCTION AND DISCHARGE IN GASES.

1578. Discharge in Gases at Normal Temperatures and Pressures. J. D. Stephenson. *Phys. Soc., Proc.* 45. *pp.* 20–39; *Disc.*, 39–40, *Jan.* 1, 1933.—By an investigation based on corona discharge it is shown that there is a fixed constant, the true breakdown strength of the gas, for all types of gas discharge at normal pressures. AUTHOR.

1579. Electric Currents from Glowing Kathodes in Gases and Vapours at Atmospheric Pressure. T. V. Ionescu. *Ann. d. Physik*, 16. 1. *pp.* 39–40, *Jan.*, 1933.—The author points out that he has previously published an account [*Comptes Rendus*, 182. *p.* 1016, 1926] of work similar to that recently described by Ruhnke [see Abstract 325 (1933)]. For the variation of the electric current with the temperature of the wire and with the potential difference between wire and anode he obtained the same results as Ruhnke, but his results for the current variation as a function of the distance between wire and anode are not in complete agreement with Ruhnke's. The differences are briefly discussed. A. W.

1580. Electric Spark and its Preliminary Discharges. A. v. Hippel. *Zeits. f. Physik*, 80. 1–2. *pp.* 19–49, *Jan.* 6, 1933.—A general view is given of various types of discharge phenomena from the point discharge to the electric penetration of solid insulators. Different conditions produce within this framework separate types of discharge. They lead from the point discharge through the brush discharge to the spark discharge, and permit the method of action of Geiger's point counter and counting tube to be understood, and indicate the significance of Lichtenberg's figures. It is shown how the electric penetration in gases depends on the preliminary discharge and how these previous histories result in characteristic types of spark. The transition to electric penetration in liquid and solid insulators is then considered. J. J. S.

1581. Glow Discharge at Atmospheric Pressure. W. Krug. *Zeits. f. techn. Physik*, 14. 1. *p.* 26, 1933.—Referring to a new form of glow discharge with a large current (0·1 to 2A) and high tension (350 to over 1000 V.) described by H. Thoma and L. Heer [see Abstract 324 (1933)], the author mentions similar observations made by him. J. J. S.

1582. Mobilities of Gaseous Ions in CH_3NO_2 — H_2 and CH_3CN — H_2 Mixtures. Elizabeth A. Higley and Carolyn C. Thorsen. *Frank. Inst., J.* 215. *pp.* 69–80, *Jan.,* 1933.—Using Loeb's methods measurements of mobilities were made in mixtures of $CH_3NO_2 - H_2$ and $CH_3CN - H_2$. The mobilities in H_2 were 7·12 for the positive ions and 10·46 for the negative ions in cm./sec. per volt/cm. Those in CH_3NO_2 were 0·221 cm./sec. per volt/cm. for both ions, and in CH_3CN they were 0·234 cm./sec. per volt/cm. for both ions. Both ion mobilities deviated from Blanc's law in CH_3NO_2 indicating the formation of complexes with the CH_3NO_2 ions somewhat greater than the normal ions in H_2. In CH_3CN mixtures both positive and negative ions deviated from Blanc's law. The negative ion had a higher mobility than the positive ion, suggesting a smaller ion and that the attaching molecule might not be CH_3CN but some impurity. Both ion addition products in CH_3CN are larger than the normal ion in H_2, but smaller than those in CH_3NO_2. J. J. S.

1583. Ignition Potentials in Noble Gases in Presence of Hg Vapour. B. Klarfeld. *Zeits. f. Physik,* 78. 1–2. *pp.* 111–122, *Sept.* 8, 1932.—The ignition potential in He, Ne and A is greatly lowered by a slight admixture of Hg vapour (Penning effect). On the other hand it is increased by small quantities of other gases as well as Hg vapour. In A the effect is so marked that it can be used as a test of purity. [See also following Abstract.] E. E. F. d'A.

1584. Ionisation by Metastable Neon Atoms Formed by Resonance Radiation. F. M. Penning. *Zeits. f. Physik,* 78. 7–8. *pp.* 454–469, *Oct.* 12, 1932.—The current flowing between two cylindrical electrodes in Ne at 40mm. pressure arising from the absorption of resonance radiation is investigated as a function of (1) the p.d. between the electrodes and (2) the admixture of A. In agreement with earlier observations on the excitation potential of Ne it is shown that a small admixture has a large influence, the current in (Ne + 0·003%A) being 24 times that for pure Ne with a p.d. of 20 volts. Whilst the current in pure Ne is ascribed to a release of electrons from the kathode, the magnification is ascribed to ionisation by metastable Ne atoms. The application of Langmuir's formula for a current in pure Ne is discussed. Ionisation by collision of electrons in a mixture of Ne and A is investigated over a greater range of potential, and a greater difference occurs with the inner cylinder as kathode than as anode, caused by the greater field-strength near the inner cylinder. If all electrons produced pass through this region quickly the ionisation is stronger than when the field is reversed. This provides an explanation of the much stronger influence of the excitation potential when the outer cylinder was a kathode. A certain irregularity in the characteristic is indicated as a space-charge phenomenon; approximately with a current of 10^{-9} ampere the space-charge can exercise a considerable influence. Measurements with a tube constructed with another electrode arrangement confirm the result. [See Abstract 2080 (1932) and preceding Abstract.] R. S. R.

1585. Neutralisation and Ionisation of High-Velocity Ions of Neon, Argon and Krypton by Collision with Similar Atoms. H. F. Batho. *Phys. Rev.* 42. *pp.* 753–765, *Dec.* 15, 1932.—The free path for (1) the ionisation of an atom (L_0), and (2) the neutralisation of an ion (L_1), has been determined for the gases neon, argon and krypton for the velocity range corresponding to accelerating potentials of 10,000 to 22,000 V. In every case the free path for ionisation, reduced to 760 mm. pressure, is found to be approximately $6 \cdot 5 \times 10^{-4}$ cm. The lengths of all the free paths are found to depend upon the pressure, and the manner of this dependence is compared with theory. A. H.

1586. Positive Ion Current at the Kathode in the Glow Discharge. A. K. Brewer and R. R. Miller. *Phys. Rev.* 42. *pp.* 786–794, *Dec.* 15, 1932.—The positive ion current passing through a perforation in the kathode of a glow-discharge tube has been measured with various types of collectors and the factors influencing the ratio of positive ions to total current studied. At pressures above 0·5 mm. the positive ion current is only a small fraction of the total current, whilst at lower pressures it increases inversely with the pressure, reaching approximately half the total current below 0·01 mm. The fraction of the current carried by positive ions is independent of the size and shape of the perforation, of the current passing through the discharge, and of the position of the anode provided it is not within a certain critical distance from the edge of the Crookes dark space; it does, however, vary with the gas, increasing for decreasing molecular weight. The method by which the current due to positive ions is separated from that due to metastable molecules is described. The energy of the positive ions passing through the kathode is shown to correspond to an appreciable fraction of the kathode fall of potential. W. R. A.

1587. Development of the Maxwellian Distribution in Langmuir's Plasma. D. Gábor. *Phys. Zeits.* 34. *pp.* 38–45, *Jan.* 1, 1933.—The development of the Maxwellian distribution in Langmuir's plasma is discussed theoretically, taking account of (1) the opposing field, (2) the to-and-fro swinging of the electron energy and (3) the space-charge effects. Calculations of relaxation times for particular conditions give results very much less than those calculated by Langmuir, but still considerably greater than the values found experimentally. Possible causes of the difference between the theoretical and experimental values are suggested. A. W.

1588. Positive Column Phenomena. H. Wulfhekel and R. Seeliger. *Phys. Zeits.* 34. *pp.* 57–59, *Jan.* 15, 1933.—Further investigation of positive column phenomena is described and discussed in its bearing on the theory of the positive column. [See also Abstract 3397 (1932).] A. W.

1589. Surface Motion of Sputtered Particles. R. W. Ditchburn. *Cambridge Phil. Soc., Proc.* 29. *pp.* 131–135, *Jan.* 31, 1933.—To test whether a surface motion exists in the case of sputtered particles of cadmium similar to that known to exist in the case of vaporised particles of cadmium an experiment was performed in which a tapering slit was placed in front of the target. The manner in which the cadmium film was built up on the target gave evidence that the sputtered particles have a surface motion. G. G. S.

1590. Relation between Ionisation and Ionisation Current in Gases at High Pressures. W. R. Harper. *Cambridge Phil. Soc., Proc.* 29. *pp.* 149–155, *Jan.* 31, 1933.—The phenomena which limit saturation in a high-pressure ionisation chamber are examined with particular reference to the rôle played by preferential recombination,

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19

that is, recombination between an ejected electron (or negative ion, if it has become one) and its parent positive ion. Limitations of the simple theory are pointed out and conditions to be satisfied by a more complete theory are stated. F. C. C.

1591. Electric Electron Condensing Lens. H. Johannson and O. Scherzer. *Zeits. f. Physik,* 80. 3–4. *pp.* 183–192, *Jan.* 23, 1933.—A formula is developed for obtaining the focal length of the short type of electric condensing lens for electrons. This formula permits the focal length of such lenses to be calculated from a knowledge of the potential field of the lens for given values of E_L/E_O, that is, of the ratio of the lens potential to the accelerating potential. The formula was tested on an actual lens and its general correctness established. The value obtained experimentally for the focal length was found to be in very good agreement with the theoretical result. [See also Abstract 5201 (1932).] A. W.

1592. Theory of Electric Electron Condensing Lens. O. Scherzer. *Zeits. f. Physik,* 80. 3–4. *pp.* 193–202, *Jan.* 23, 1933.—The formula given in a previous paper [see preceding Abstract] for the focal length was only a first approximation. A second approximation is here given and a method is described for calculating the errors of such lenses. As an example the spherical aberration is calculated for a particular lens on which the electron rays are incident in directions parallel to the axis. A discussion is also given of the relations from which the most suitable electrode shapes can be calculated. A. W.

1593. Spectroscopic Study of the Decomposition and Synthesis of Organic Compounds by Electrodeless and Glow Discharges. W. D. Harkins and J. M. Jackson. *J. Chem. Phys.* 1. *pp.* 37–47, *Jan.,* 1933.—The results obtained with various hydrocarbons, pyridine, benzaldehyde, thiophene, and phenol show that, in the chemical reactions occurring in electrical discharges through organic vapours and in the maintenance of the discharge, the simple ionisation of the molecules and the resultant formation of clusters are less, and the degradation into molecular, atomic and ionic fragments more, important than hitherto supposed. The fragments revealed by the spectroscope are CH, OH, NH, C_2, CN, N_2, CO^+, CS, S_2, H_2, C, C^+, H, and S, and H_2O and NH_3 are known to be formed also. With the electrodeless discharge, the rate and nature of the reaction and the spectrum emitted are affected by the hydrogen to carbon ratio in such a way that the rate of reaction decreases as this ratio increases, and the fraction of gaseous products and the intensity of the spectra emitted by molecules which contain hydrogen increase with this ratio. With the glow discharge, both saturated and unsaturated hydrocarbons are decomposed at about the same rate to form the products mentioned above. The decomposition products from the glow unite to form brown or black solids somewhat similar to those formed with the electrodeless discharge. From the way in which the product is deposited and the intensity of the spectrum, the reaction is seen to be most rapid at the kathodeward edge of the negative glow. T. H. P.

1594. Behaviour of Neon Tubes in a Flashing Capacity Circuit. J. H. J. Poole. *Roy. Dublin. Soc., Proc.* 20. *pp.* 477–486, *Jan.,* 1933.—In previous papers [see Abstracts 113 (1929) and 616 (1931)] a method of using a flashing neon tube circuit and a photoelectric cell as a convenient field photometer was described. The present paper gives an account of an investigation of the behaviour of neon tubes in flashing circuits by means of a kathode-ray oscillograph. Details are given of the experimental arrangements, and the results obtained are presented in a number of diagrams and photographs. A. W.

See also Abstracts 1258, 1342, 1401, 1421, 1484, 1485, 1548, 1629, 1655.

CONDUCTION IN SOLIDS AND LIQUIDS.

1595. Theory of the Change of Electric Resistance in Metals Caused by Hydrostatic Pressure. K. Honda, T. Nishina and T. Hironé. *Tohoku Univ., Sci. Reports,* 21. *pp.* 851–868, *Dec.,* 1932. *In English. Report No.* 297 *of the Research Inst. for Iron, Steel and Other Metals.*—The changes of electric resistance in metals caused by hydrostatic pressure are explained by the Höjendahl-Frenkel theory of free electrons based on the Thomas-Fermi theory of electron distribution around the nucleus of the atom and by taking account of the mutual impacts of free electrons. It is a very important fact that, in electric resistance-pressure curves, the existence of a minimum resistance in Cs and a steady increase or decrease of resistance in Li, Bi, Sb, Ca, Sr, or in Cu, Au, Al, Pb, Ni, Pd and others, by pressure, are explained by the authors' simple theory. It is also to be expected from the same theory that metals, the resistance of which decreases at first with pressure, should have their minimum at a very high pressure not yet reached. AUTHORS.

1596. D.C. Amplifier with Good Operating Characteristics. A. H. Taylor and G. P. Kerr. *Rev. Sci. Instruments,* 4. *pp.* 28–32, *Jan.,* 1933.—Describes a design of amplifier for the direct current from a photoelectric cell. The calibration is particularly constant, varying on the average only 0·8% from day to day over a period of six days. The original paper should be consulted for constructional details. J. H. A.

1597. Pressure Coefficient of Resistance at Liquid Oxygen Temperatures. P. W. Bridgman. *Am. Acad., Proc.* 67. *pp.* 305–344, *Dec.,* 1932.—It is known that alkali metals have a mimimum of resistance at high pressures and the author has searched for signs of a similar minimum in other metals at much higher pressures. An appearance of supraconductivity at these pressures is also looked for. Specimens of the following elements, Pb, Mg, Al, Ag, Au, Cu, Ni, Fe, Pd, Cb, Pt, Rh, Mo, Ta, and W are extruded into wire form and are then subjected to pressures of up to 7,000 kg./cm.^{2} in a specially constructed vessel maintained at the temperature of liquid oxygen. A detailed account of the construction of the apparatus is given. Pressures were measured by the change of resistance of a calibrated manganin wire. Much trouble was caused by the bursting of the vessels under the pressures used but finally a special Cr-Mo steel was discovered which would normally withstand a pressure of up to 7,000 kg./cm.^{2} without bursting. It was found possible to remove residual porosity of the steel by a previous filling of the vessels at room-temperature with nitrogen at high pressure when absorption of this gas blocked the pores in the metal. In practice it was found necessary to raise and lower the pressure several times before the results became reproducible. It is deduced that there is no evidence either of a minimum resistance or of supraconductivity. J. E. R. C.

1598. Effect of Tension on the Resistance of Single Bismuth Crystals. Mildred Allen. *Phys. Rev.* 42. *pp.* 848–857, *Dec.* 15, 1932.

The compensated potentiometer method of measuring minute variations in small resistances was used in the study of the effect of tension, applied parallel to the direction of current flow, on the resistance of single bismuth crystals. The tension coefficient of resistance at 30° C. was found to depend on the orientations of the principal and secondary cleavage planes with respect to the tension. For the limiting case of the principal cleavage plane perpendicular to the tension the coefficient is independent of the orientation of the secondary cleavage planes; in that of the principal cleavage plane parallel to the tension the coefficient varies very little. In the case where the normal to the principal cleavage plane makes an angle of about 60° with the tension the variation of the coefficient with the orientation of the secondary cleavage plane seems to be a maximum. This variation involves a change of sign as well as of magnitude, so that for certain orientations the coefficient becomes positive instead of negative. The coefficient shows trigonal symmetry corresponding with the trigonal symmetry of the bismuth crystal. J. J. S.

1599. Effect of Homogeneous Mechanical Stress on the Electrical Resistance of Crystals. P. W. Bridgman. *Phys. Rev.* 42. *pp.* 858–863, *Dec.* 15, 1932.—From considerations of symmetry the effect of homogeneous mechanical stress on the electrical resistance of a conducting crystal can be expressed in terms of a set of constants the number of which is equal to the number of elastic moduli. These connect the resistance with stress by equations resembling those connecting strain with stress. The results are applied to the case of bismuth, and formulæ are developed for the change of resistance of a rod cut from the crystal in any direction when subjected to longitudinal tension. The formulæ agree with the recent experimental results of M. Allen [see preceding Abstract]. Numerical values of the six constants are given for bismuth. An effect is produced by stress in crystals which is the analogue of the Hall effect produced by a magnetic field in isotropic materials. J. J. S.

1600. Restoration of the Electrical Resistance and Hardness of Copper, Silver, Gold, Platinum and Palladium from the Consequences of Mechanical Treatment when Cold. G. Tammann and K. L. Dreyer. *Ann. d. Physik,* 16. 1. *pp.* 111–119, *Jan.,* 1933.—On plastic deformation the electrical resistance and hardness of metals increase. As during these processes the changes of resistance and hardness cannot be determined the changes in these characteristics on heating the metals previously deformed when cold must be followed. A hard wire or rolled strip with a determined degree of stretching or rolling and a soft annealed piece of the same wire were wrapped up beside each other on a strip of asbestos and placed in a tube furnace and there raised to a definite temperature. The difference of the resistances of the two wires in dependence on the time during a series of successively raised temperatures was measured. Thus the percentage change of resistance $\Delta\omega \times 100/\omega$ was obtained. Thus the behaviour of Cu, Ag, Au, Pt, and Pd was examined and the results are given in curves and tables. J. J. S.

1601. Electrical Conductivity of Mercury at High Temperatures. W. Braunbek. *Zeits. f. Physik,* 80. 3–4. *pp.* 137–149, *Jan.* 23, 1933.—Measurements were made of the conductivity of Hg up to 900° C. at 300 atmospheres pressure. The pressure coefficient of the conductivity between 300 and 600 atmospheres up to 600° C. was also observed. The experimental methods for obtaining the pressures used and the various methods adopted for the measurement of the conductivity are described, and the results of the measurements are given. Recent measurements over a wide range of pressure and temperature have been made on the conductivity of Hg by Birch in America who has also established the critical point of Hg at 1460° C. and 1640 atmospheres. At corresponding temperatures the author's results and those of Birch are in agreement. J. J. S.

1602. Theory of Supraconductivity. Part II. R. de L. Kronig. *Zeits. f. Physik.* 80. 3–4. *pp.* 203–216, *Jan.* 23, 1933.—Certain quantitative developments of the theory of supraconductivity already given [see Abstract 344 (1933)] are studied. Applying wave mechanics, it is shown that if the electrons are conceived as forming a rigid three dimensional lattice then the system of potential barriers in the crystal will prevent any electric current being set up. If, however, the electrons are coupled in linear chains, translational motion of these chains is possible on certain conditions, and supraconductivity is to be attributed to such motion. The conditions mentioned explain why only elements of small atomic volume and with several external electrons can function as supraconductors. W. S. S.

1603. Conductivity of Aluminium Chloride in Non-Aqueous Solutions. E. Wertyporoch and T. Firla. *Zeits. f. phys. Chem.* 162. *Abt.A.* 6. *pp.* 398–414, *Dec.,* 1932.—Owing to solvation of the autocomplex, the molar conductivity of $AlCl_3$ in C_2H_5Cl is about double that of $AlBr_3$ in C_2H_5Br, but shows the same constancy over a considerable range of concentration. Marked stability is thus indicated for the autocomplexes, which are not appreciably decomposed on dilution but, owing to its low concentration, are completely dissociated. With propyl, isopropyl, and cyclohexyl chlorides, the molar conductivity is about 30 times as great, owing to formation of propylene or cyclohexene and its association with the complex. Still higher molar conductivities are observed with benzoyl and acetyl chlorides, so that here also—without any pre-reaction combined with loss of hydrogen chloride—salt-like complexes are formed with aluminium chloride, the carbonyl compounds passing, like the unsaturated hydrocarbons, into the kation. The results of transference experiments with ethyl chloride as solvent show, just as with ethyl bromide, migration of four hydrocarbon molecules with one aluminium atom to the kathode. T. H. P.

1604. Properties of Electrolytic Solutions. Part I. Conductance as Influenced by the Dielectric Constant of the Solvent Medium. C. A. Kraus and R. M. Fuoss. *Am. Chem. Soc., J.* 55. *pp.* 21–36, *Jan.,* 1933.—Data are reported for the conductances of the following systems at 25° over the concentration range $0{\cdot}2 - 0{\cdot}00001\,N$: tetraisoamylammonium nitrate in dioxan, water, ethylene dichloride and mixtures of the last named and of water with dioxan; tetraisoamylammonium thiocyanate in dioxan, benzene and a mixture of benzene and ethylene dichloride; tri-isoamylammonium picrate in ethylene dichloride, benzene, and a mixture of these two solvents. At sufficiently low concentrations the equivalent conductance increases with dilution, even in solvents of very low dielectric constant. The influence of the latter on conductance was determined over the range from dioxan to water, and it was found that, viscosity excepted, specific influences due to the solvents are not marked. The behaviour of strong and weak electrolytes is compared. N. M. B.

1605. Electrical Conductivity of Mixed Salt Solutions. A. K. Smith and R. A. Gortner. *J. Phys. Chem.* 37. *pp.* 79–86, *Jan.*, 1933.—The electrical conductivities were determined at a temperature of 30·17° C. of mixtures of sodium chloride with copper sulphate, zinc sulphate, sodium sulphate, and magnesium chloride, of magnesium chloride with sodium sulphate and magnesium sulphate, and of potassium chloride and hydrochloric acid. The results showed no regularity to enable a generalisation to be made. F. J. B.

1606. Electrical Conductivities of Mixtures of Sulphuric Acid, Acetic Acid and Water. N. F. Hall and H. H. Voge. *Am. Chem. Soc., J.* 55. *pp.* 239–246, *Jan.*, 1933.—The conductivities of dilute solutions of sulphuric acid in acetic acid were carefully redetermined. It is shown that the solute behaves as a typical weak electrolyte, and its dissociation constant was calculated as 10. The complete conductivity curves for the binary system $H_2SO_4-CH_3COOH$ were determined and are discussed in connection with similar curves for the systems $H_2SO_4-H_2O$ and H_2O-H_3COOH. The complete conductivity diagram is given for the system $H_2SO_4-CH_3COOH-H_2O$. F. J. B.

1607. Voltage Effect with Strong and Weak Bases. J. Schiele. *Phys. Zeits.* 24. *pp.* 60–61, *Jan.* 15, 1933.—Whereas with the strong bases sodium and barium hydroxides the voltage effect is small, *viz.*, about 1·7 % for 0·0008 *M* solutions at 260 kV per cm., with ammonia it amounts to about 13 % for a 0·031 *M* solution, and with methylamine to about 10 % for a 0·0023 *M* solution, under the same conditions. The effect in the case of the weak bases falls considerably with reduction of concentration. A solution of commercial agar-agar showed a voltage effect of 28 % at 140 kV per cm., but considerable electrolytic impurity was present; on removing this the effect increased three-fold. Temperature appears to exert but little influence on the voltage effect with colloidal solutions. H. F. G.

1608. Transverse Conductivity of Solid Dielectrics. W. Hubmann. *Zeits. f. Physik,* 80. 3–4. *pp.* 252–257, *Jan.* 23, 1933.—It is known that the conductivity of solid dielectrics increases slowly with increase of the applied electric field and in an attempt to elucidate this phenomenon the authors have measured the conductivity of such a dielectric in a direction perpendicular to a strong electric field. To avoid polarisation effects the latter was provided by an alternating potential difference. Minor investigations were made upon salts such as LiBr and upon mixtures such as asphalte, but the principal experiments were made with glass in the form of a plate. It was noted that the conductivity increases with increasing temperature by about 6 % per ° C. No definite change of transverse conductivity appears to result from a change in the electric field. J. E. R. C.

1609. Current Conduction in a Dielectric. W. O. Schumann. *Zeits. f. techn. Physik,* 14.1. *pp.* 23–26, 1933.—The paper is a continuation of previous work on the theory of current conduction in dielectrics [see Abstract 1169 (1933)]. The case now studied is that where a small ohmic conductivity exists and in addition a charged layer moves from one electrode, to travel in the dielectric under the electric field. The result shows that for a direct e.m.f. the current will be relatively large at first, gradually falling to the value conforming to Ohm's law. The time during which the current is decreasing depends on factors which are determined theoretically. The phenomena in the case of an applied alternating e.m.f. are also considered. J. H. A.

1610. Electric Conductivity of Commercial Dielectrics and its Variation with Temperature. J. D. Clark and J. W. Williams. *J. Phys. Chem.* 37. *pp.* 119–131, *Jan.*, 1933.—In order to obtain the variation with temperature of the resistance of materials usually known as dielectrics, a modification of a Wheatstone bridge is used, a null method being more reliable. The ratio arms are replaced by voltages, a potentiometer being used on the l.t. side so that the voltage may be accurately known. A Compton electrometer is used in place of the galvanometer. Details are given of the treatment of the specimens, which include six synthetics and four woods. Results are shown as straight line graphs between the logarithm of the specific volume conductivity and reciprocal of the absolute temperature. Possible mechanisms of the conduction process are briefly discussed. H. M. B.

See also Abstracts 1274, 1338, 1659.

DIELECTRICS AND CAPACITANCE.

1611. Dipole Moment of Nitric Oxide. C. P. Smyth and K. B. McAlpine. *J. Chem. Phys.* 1. *pp.* 60–61, *Jan.*, 1933.—The dielectric constant of nitric oxide is measured over a wide range of temperature and used to calculate the dipole moment of the molecule, which is found to be less than $0{\cdot}1 \times 10^{-18}$, and so small as to be indistinguishable from zero. AUTHORS.

1612. Configurations of the Aldoximes from Measurements of Electric Dipole Moment. T. W. J. Taylor and L. E. Sutton. *Chem. Soc., J. pp.* 63–65, *Jan.*, 1933.—The substances investigated were the *o*-methyl ethers of the *p*-nitrobenzophenone oximes and of the *p*-nitrobenzaldoximes, their dipole moments indicating the syn- and anti-configurations for the α- and β-forms respectively. H. H. Ho.

1613. Dielectric Polarisation. Part V. Benzene Solutions of Pyrones, Thiopyrones and Thioketones. Dioxan Solutions of Ureas and Thioureas. E. C. E. Hunter and J. R. Partington. *Chem. Soc., J. pp.* 87–90, *Jan.*, 1933.—An important difference between oxygen and sulphur is exhibited in the relatively much greater ease with which the latter element can increase in valency by co-ordination or by the formation of charged ions [see Abstract 4267 (1931)], and the present paper extends previous work [see Abstract 1178 (1933)] by recording the dipole moments ($\mu \times 10^{18}$) of dimethyl-γ-pyrone (4·05), diphenyl-γ-pyrone (3·82), dimethylthio-γ-pyrone (5·05), thiobenzophenone (3·37), dioxan (0·40), *s*-dimethylurea (4·8), *s*-diethylthiourea (4·9), carbanilide (4·6), and thiocarbanilide (4·85). The chemical properties of these compounds are discussed, and also the mechanism of the formation of oxonium salts. H. H. Ho.

1614. Measurement of Dipole Moments by Means of a Molecular-Ray Method. M. Wohlwill. *Zeits. f. Physik*, 80. 1–2. *pp.* 67–79, *Jan.* 6, 1933.—A method of determining the intensity of molecular rays by the heat produced in the condensation of the impinging molecules is discussed from the theoretical and experimental standpoint. The method has been applied to the molecular radiation from *p*-nitraniline; and by considering the intensity distribution it is possible to evaluate the electric moment of the molecule quantitatively. Results are in very good agreement with previous values obtained by the usual methods of dipole moment measurements. W. R. A.

1615. Dielectric Constant of Aqueous Solutions. M. Jeżewski. *Phys. Zeits.* 34. *pp.* 88–94, *Jan.* 15, 1933.—The dielectric constant of such imperfect insulators can be obtained at h.f. by the substitution, in a resonant circuit, of a perfect condenser and known resistances for the imperfect condenser containing the aqueous solution. The probable causes of inaccuracy are fully discussed and investigated. The precautions which it is necessary to observe in order to obtain reliable results are fully demonstrated. A. J. S.

1616. Capacitance Hygroscopy and Some Applications. W. L. Balls. *Nature*, 130. *pp.* 935–938, *Dec.* 17, 1932.—Indication of changes in water content of samples is given by a portable apparatus (weight 8 kg.), comprising a weak oscillator (2 MC/S) loosely coupled to a "resonator" and a valve voltmeter, and operated with the "potential tuning" due to Lattey and others. The resonator consists of a coupling coil, the sample condenser and ballast, tuning and zero-setting condensers, all shunted across grid and filament of the second valve. The sample condenser varies according to the application. For soil water determinations buried electrodes of thin glass filled with mercury are used, the leads being air-spaced in a gas-pipe. For cotton bales connection is made direct to the iron hoops—widely spaced to test the whole bale; alternate hoops to test the surface layer (this shows the effect of exposure to weather conditions). For growth of crops aerial wires stretched over the crop, and a counterpoise pegged beneath, are connected to the terminals. Although at present the method suffers from drift due to temperature, earth capacity changes and frequency wandering, it yields accurately comparative readings in repetition work. **R. K. Schofield,** *Ibid.*, 131. *pp.* 96–97, *Jan.* 21, 1933, points out that the apparatus indicates the equivalent parallel capacity of the sample condenser and gives examples of the behaviour of the sample with different ratios of its pure capacity and resistance components and also shows that information on them is obtainable by using different frequencies. References are made to tests by G. H. Cashen using a compensated bridge method. R. M.

See also Abstracts 1296, 1580, 1604, 1632, 1653.

ELECTROCHEMISTRY.

1617. Galvanic Cells Containing Potassium Triphenylmethyl. H. E. Bent and E. S. Gilfillan, Jr. *Am. Chem. Soc., J.* 55. *pp.* 247–249, *Jan.*, 1933.—Potassium triphenylmethyl and some related compounds were found to behave as normal electrolytes in galvanic cells containing amalgamated electrodes. It is shown that potassium triphenylmethyl and some related compounds undergo a slow irreversible reaction in contact with potassium which prevents their use in galvanic cells containing potassium. F. J. B.

1618. Anodic Oxidation of Benzene. R. M. Archibald. *Roy. Soc. Canada, Trans.* 26. *pp.* 69–73, *May*, 1932.—Electrolysis of solutions of benzene in glacial acetic acid to which 12·5 vol.-% of concentrated sodium hydroxide solution has been added yields an equilibrium mixture of phenol and higher oxidation products. The maximum phenol concentration (1·76%) is obtained by using a diaphragm, a dilute solution (about 12%), and a relatively high (*i.e.*, 10–30) voltage, and by adding a trace of a multivalent metal such as copper. The anodes may be of copper, nickel, iron, or preferably platinum. A.c., either alone or superimposed on d.c., results in smaller yields than are obtained with d.c. alone. The current-voltage curve indicates that no definite decomposition potential exists in the range 0–5 volts. H. F. G.

1619. **Qualitative Analysis by Means of Electrolysis and Spectrography. A. Schleicher.** *Zeits. f. Elektrochem.* 39. *pp.* 2–7, *Jan.*, 1933.—The principles of the combined electrolytic and spectrographic method of analysis are outlined, and practical details and typical results are described. The method is applicable to from 10 to 1000 microg. of metals at a limiting concentration of 1 in 10^{-6} to 1 in 10^{-7}. H. F. G.

1620. **Electrolytic Separation of Platinum. G. Grube and D. Beischer.** *Zeits. f. Elektrochem.* 39. *pp.* 38–45, *Jan.*, 1933.—Previous work [see Abstract 3652 (1931)] is now supplemented by the present investigation, wherein it is found that the best separations of platinum are obtained from sodium ammonium phosphate solutions as well as from ammoniacal dinitrito-diammino platinum solution. It is shown from the current density-potential curves that, corresponding to the complex union of the platinum with the electrolyte, the separation of the platinum may be accompanied by hydrogen. With potassium platino-cyanide solutions only hydrogen is evolved at all the kathode metals investigated with the exception of mercury, at which reduction also occurs with, however, no separation of platinum. H. H. Ho.

1621. **Electrophoretic Effect of the Concentration Effect. J. Schiele.** *Phys. Zeits.* 34. *pp.* 61–64, *Jan.* 15, 1933.—In all the cases investigated, not only the relaxation effect, but also the electrophoretic effect is raised by the potential effect [see Abstract 1457 (1932)]. The ionic concentration effect, as calculated by Debye and Onsager, was never quite attained, since the boundary effect for the electrolytes used could not be measured, but the value could be deduced from the course of the potential effect. H. H. Ho.

1622. **Potentiometric Titration Method for Fluorine. N. Allen and N. H. Furman.** *Am. Chem. Soc., J.* 55. *pp.* 90–95, *Jan.*, 1933.—A potentiometric titration method for fluorine, involving the precipitation of cerous fluoride, has been developed by means of a new application of the ferri-ferrocyanide electrode. The method gives good results for amounts of fluorine ranging from 0·1 to 50 mg. Small amounts of foreign salts do not interfere, but large amounts mask the equivalence point. Ions, other than F., which precipitate cerous cerium must be absent. Analyses of a Bureau of Standards sample of fluorspar by this method gave the average percentage of F. at 46·56, instead of 46·20. T.H.P.

1623. **Influence of Acid Concentration on the Oxidation-Reduction Potential of Mixtures of Ferric and Ferrous Sulphates in Sulphuric Acid Solution. T. J. Glover.** *Chem. Soc., J. pp.* 10–15, *Jan.*, 1933.—The e.m.f. of cells in which the oxidation-reduction half-element consists of a mixture of ferrous and ferric sulphates in sulphuric acid bears a logarithmic relation to the ferric : ferrous ratio at both 20° C. and 60° C. The temperature coefficient of the e.m.f. rises with increase of the sulphuric concentration from 0·1 to 1·0 *N*, and then remains constant up to 10 *N*. The oxidation-reduction electrode potentials in 0·1 and 1·0 *N* sulphuric acid are 0·9548 and 0·9559 volt, respectively, at 20° C. and 0·9798 and 0·9961 volt, respectively, at 60° C. The influence of acid concentration on the e.m.f. is less than in the case of a chloride solution. It is suggested that in chloride, and, under certain conditions, in sulphate solutions, complex ferrous and ferric ions are formed, and that these complexes set up a new oxidation-reduction system which may partly or wholly replace the original system ; the amount and composition of the complexes may vary with the acid concentration, which will therefore influence the observed potential. The temperature coefficient of the N-mercurous sulphate electrode between 20° C and 60° C has been determined as $2 \cdot 83 \times 10^{-4}$ volt. H. F. G.

1624. Modified Circuit for Routine Use of the Glass Electrode. E. C. Gilbert and A. Cobb. *Indust. and Engin. Chem.* (*Analytical Edition*), 5. *pp.* 69–70, *Jan.* 15, 1933.—A description of a simplified circuit for the routine use of glass electrodes in which a valve potentiometer is embodied. The use of the apparatus for the determination of pH values is explained. F. J. B.

1625. Metal-Connected Glass Electrode. M. R. Thompson. *Bureau of Standards, J. of Research*, 9. *pp.* 833–853, *Dec.*, 1932.—Glass electrodes with a direct metallic connection were constructed by the deposition of the metal upon the glass by one of the well-known processes. The glass was in the form of test tubes. The electrodes had good accuracy and sensitivity and had an indefinite life, their usefulness lasting months or years. Oxidation-reduction potentials were found to have little, if any, effect with this or other types of glass electrodes. F. J. B.

1626. Determination of the Mass of Electrolytic Ions. P. Debye. *J. Chem. Phys.* 1. *pp.* 13–16, *Jan.*, 1933.—The theory of a new method for determining the mass of electrolytic ions is developed from the standpoint of wave theory. The paper does not lend itself to a short abstract, and the original must be consulted for details of the calculations. F. J. B.

See also Abstracts 1257, 1262, 1603.

ELECTRONS AND PROTONS.

1627. Charge on Selenium Particles at High Gas Pressures. F. Ehrenhaft. *Zeits. f. Physik.* 80. 5–6. *pp.* 402–411, *Jan.* 31, 1933.—It is claimed that E. Wasser's paper [see Abstract 377 (1933)] contains both theoretical and experimental errors, and that the conclusions of Wasser regarding the non-existence of charges smaller than that of the electron are false. H. F. G.

1628. Effective Cross-Sections of Atoms with Respect to Slow and Fast Electrons. R. L. Rosenberg. *Ann. d. Physik*, 15. 7. *pp.* 757–786, *Dec.*, 1932.—The force which a plane material wave exerts on a spherically symmetrical potential region is calculated. The result is

applied to the scattering of electrons by atoms in order to obtain an expression for the effective cross-section in the form of a series of coefficients. The method is illustrated by taking the atomic model of Allis and Morse as a special case; the results are plotted graphically. The anomalies of the Ramsauer-Townsend effect are discussed, and the positions of the maxima are calculated approximately. By using asymptotic expressions for the functions that occur the transition to higher velocities is effected, and an approximate value is obtained for the effective cross-section.
H. L. B.

1629. Energy Exchanges in Corpuscular Collisions. R. Döpel. *Ann. d. Physik,* 16. 1. *pp.* 1–36, *Jan.,* 1933.—He-atoms are caused to emit light by excitation by means of H-canal rays of velocities ranging from 2 to 40 kV. It is found that the excitation of He by protons lies below the limit of observation and may be neglected in comparison with the excitation by H-atoms in the canal rays. H-atoms of less than 2000 V fail to excite He, that is, the collisions are elastic with regard to the He, but H itself is excited as far down as 500 V. The excitation function for collisions between H and He may be regarded neither as a general function of the energy nor as a function of the de Broglie wave-length of the impinging particle. Simple ideas of collisions lead the author to conclude that the decisive factor for energy exchange in collisions is not the total energy of the impinging particle but the transferable energy. The excitation function has approximately the same character for any impinging particles whatsoever, so long as the transferable energy is chosen as the parameter. No collision theory can be regarded as adequate unless it takes into account the conception of transferable energy. The theory is shown to hold well for experimental results obtained with various atoms.
H. L. B.

1630. Electron Scattering in Helium. Absolute Measurements at 90° and 45°. S. Werner. *Roy. Soc., Proc.* 139. *pp.* 113–129, *Jan.* 2, 1933.—In a previous paper the author has shown that the scattering of electrons from a beam of electrons in a gas can be determined experimentally by measuring the number of scattered electrons which pass through ring-slits arranged round the beam. This principle is used in an apparatus here described in detail. The scattered intensity is found experimentally at velocities corresponding to 30–400 V and at scattering angles, 90° and 45°. The results are compared with the nuclear scattering according to Rutherford's formula and with the scattering according to Mott and Bethe's calculations. Agreement is found at velocities above 150 volts, but there are large deviations at smaller velocities. H. L. B.

1631. Collison of Slow Electrons with Atoms. Part II. General Theory and Inelastic Collisions. H. S. W. Massey and C. B. O. Mohr. *Roy. Soc., Proc.* 139. *pp.* 187–201, *Jan.* 2, 1933.—The theory of collisions of slow electrons with atoms given in a previous paper [see Abstract 3901 (1932)] has been extended to include the effect of the distortion of both the incident and scattered electron waves by the static field of the atom, together with the effect of electron exchange. Using this method the inelastic scattering of slow electrons in helium is considered for the case of the excitation of the 2^1P and 2^3P states of the atom. It is seen that the effect of the distortion does not introduce any great modification of the form of the inelastic cross-section curves, and the lack of agreement with experiment at quite low velocities is thought to be due to the neglect of other complicating factors in the theory, in particular the effect of polarisation. The theory is adequate to explain the observed effect of the diffraction of inelastically scattered electrons by heavy atoms. AUTHORS.

1632. Velocity Distribution of the Secondary Electrons Liberated from Insulators. G. Kalckhoff. *Zeits. f. Physik*, 80. 5–6. *pp*. 305–323, *Jan*. 31, 1933.—Using the magnetic method the velocity distribution of the secondary electrons liberated from glass and mica, was determined for different angles of incidence i and velocities u_p of the primary electrons. The total number of secondary electrons when plotted against i shows a characteristic discontinuity at a particular angle, provided the energy of the primary electrons exceeds a certain limit (about 1500 V). A similar relation was found for the velocity distribution. Plotting the electron velocity u_m corresponding to the maximum number of secondary electrons, against the angle of incidence i, u_m was found to be independent of i for primary electron energies less than 1500 V, but for greater primary energies the curve showed a characteristic discontinuity at a particular angle which coincided with that at which the total number of emitted secondary electrons exhibited an abrupt variation. W. S. S.

1633. Electron Diffraction by Amorphous Carbon. C. Mongan. *Helv. Phys. Acta*, 5. *pp*. 341–350, *Nov*., 1932. *In German*.—An apparatus is described which enables electron diffraction experiments to be performed with powders. The results obtained for magnesium oxide, graphite and amorphous carbon are given. The author shows that it is possible to apply the method to determine the sizes of the particles of amorphous carbon. He obtains the value 30 Å for the diameter of carbon particles obtained from the deposition of smoke from turpentine. Those obtained from smoke emitted by burning acetylene are somewhat smaller. H. L. B.

1634. Diffraction of Kathode Rays by Single Crystals. Part III. Simultaneous Reflection. K. Shinohara. *Inst. Phys. and Chem. Research Tokyo, Sci. Papers, No*. 401. *pp*. 39–51, *Dec*., 1932. *In English*.—In the case of kathode-ray diffraction from the cleavage face of various crystals a phenomenon is observed similar to that of *Aufhellung* in the case of the reflection of a homogeneous beam of X-rays from two net-planes which simultaneously satisfy Bragg's condition. This phenomenon presents itself in the form of curved black lines in the so-called *p*-patterns [see Abstract 4549 (1932)]. These curved black lines may be conceived as an envelope of ordinary black lines belonging to a common zone; they deviate from straightness in the neighbourhood of the tangent point and then fade out. Another pattern consisting of short black lines across dark bands are also observed and is similarly explained by a dynamical theory of electron diffraction. [See also Abstract 5221 (1932).] H. L. B.

See also Abstracts 1322, 1419, 1527, 1656.

ELECTROSTATICS.

1635. Thermodynamic Analysis of Electromotive Forces. J. Villey. *J. de Physique et le Radium*, 4. *pp*. 10–20, *Jan*., 1933.—A theory of the Volta effect is developed. J. S. G. T.

1636. Spherical Particles in an Ionised Field. M. Pauthenier and (Mme.) M. Moreau-Hanot. *J. de Physique et le Radium*, 3. *pp*. 590–613, *Dec*., 1932.—The systematic study of an air-filter, a metallic tube with a cental wire at a high potential, with special reference to the maximum charge which can be carried by conducting or non-conducting particles across the tube. Among the particles the behaviour of which was examined were spheres of Rose's fusible alloy projected by compressed air from an orifice in a tube, and measuring from a few microns to 100 in diameter. They followed the appropriate path until they were embedded in a film of moist gelatin. The charge acquired by a conducting particle is $3E_0 \times a^2$, where E_0 is the field and a is the diameter of the particle. For insulating particles, 3 must be replaced by a more complex factor.

E. E. F. d'A.

1637. Sensitivity-Control for the Lindemann Electrometer. L. G. Grimmett. *Phys. Soc., Proc.* 45. *pp.* 117–118 ; *Disc.*, 118–119, *Jan.* 1, 1933.—A circuit is given for varying the sensitivity of the Lindemann electrometer by means of one adjustment only. [See also Abstract 4392 (1932).] AUTHOR.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

See Abstract 1608.

MAGNETISM AND ELECTROMAGNETISM.

1638. Analogy between Equations of the Quantum Theory and Maxwell's Equations. M. Fahmy. *Phys. Soc., Proc.* 45. *pp.* 67–69, *Jan.* 1, 1933.—A previous paper [see Abstract 2178 (1931)] dealt with an analogy between the electromagnetic equations in free space and the equations of the quantum theory, exhibited by means of five-dimensional geometry. In the present paper the analogy is pursued further and leads to the Eddington relation between the number of electrons in the universe and its radius. [See also Abstract 3937 (1932).] AUTHOR.

1639. Theory of Induced Magnetism. L. R. Wilberforce. *Phys. Soc., Proc.* 45. *pp.* 82–86 ; *Disc.*, 86–87, *Jan.* 1, 1933.—It is usually stated that if any given magnet is immersed in a medium of permeability μ the magnetic field around it is similar to that in a vacuum, but diminished in strength in the ratio of $1 : \mu$. It is here shown that this statement is inconsistent with the ascertained experimental laws of induced magnetism.

AUTHOR.

1640. Observations Relating to Bitter Bands on an Iron-Silicon Plate. R. Becker and H. F. W. Freundlich. *Zeits. f. Physik*, 80. 5–6. *pp.* 292–298, *Jan.* 31, 1933.—The phenomenon discovered by Bitter [see Abstract 5241 (1932)] is investigated in the case of a plate of silicon-iron alloy. A suspension of ferric oxide in propyl alcohol being spread over the plate, it is found that when the plate is magnetised to an intensity below saturation, deposition of ferric oxide occurs along lines marking out the individual crystallites in the plate. As saturation is approached, this deposition indicating the crystalline structure is replaced by deposition in bands transverse to the applied magnetic field. J. S. G. T.

1641. Theory of the Ferromagnetic Anisotropy of Single Crystals. R. M. Bozorth. *Phys. Rev.* 42. *pp.* 882–892, *Dec.* 15, 1932.—In single crystals of Fe and Ni the direction of magnetisation is not generally parallel to the direction of the magnetic field although these crystals belong to the cubic system. When the magnetisation in a crystal has a certain value as measured in the direction of the field there will be also in general a component of magnetisation measured in the direction at right angles. This paper describes the calculation according to the domain theory of the normal component of magnetisation, using certain assumptions almost identical with those of Heisenberg [see Abstract 3235 (1931)] in his calculation of the magnetostriction of iron crystals. Theoretical curves are given for a variety of crystallographic directions. Each of these curves shows all of the possible positions and magnitudes of the vector representing the magnetisation in iron crystals as the magnetic field parallel to any given direction in the crystal increases from zero to a high value. The theoretical curves show good agreement with the experimental curves of Honda and Kaya. J. J. S.

1642. Magnetic Moments of K and Li with Regard to their Nuclear Magnetic Moments. W. Meissner and H. Scheffers. *Phys. Zeits.* 34. *pp.* 48–53, *Jan.* 1, 1933.—The molecular-ray method was employed in an accurate determination of the magnetic moments of K and Li. The value found was $0\cdot916 \times 10^{-20}$ gauss cm. The nuclear moment of lithium lies between 5 and 0·5% of a Bohr magneton.

G. E. A.

1643. Paramagnetism of Dissolved Cobaltous Ion. R. Mercier. *Comptes Rendus*, 196. *pp.* 164–166. *Jan.* 16, 1933.—Using 1–20 × $10^{-3}N$ solutions of $CoCl_2$, $6H_2O$ in methyl alcohol the magnetic moment (in Weiss magnetons, calculated according to Langevin's law) of Co^{++} varies linearly with the temperature from 23·9 at 293° abs. to 18·1 at 177°. Assuming the fundamental state of the Co^{++} ion to be $^4F_{9/2}$ this is, within the limits of error, in agreement with the van Vleck-Stoner theory.

C. A. S.

1644. Magnetic Susceptibility of Silicon-Rich Ferro-Silicons. C. Bedel. *Comptes Rendus*, 196. *pp.* 262–264, *Jan.* 23, 1933.—The magnetic susceptibility of 12 ferro-silicons containing from 34·64 to 99·86% silicon, the iron containing only 0·03% carbon, has been determined. All are paramagnetic; the susceptibility/composition curve shows large maxima for about 34·64 and 49·8% of silicon and a smaller one for 56·86%, indicating the probable existence of $FeSi_2$, though unless cooled very slowly the susceptibility of the alloy of this percentage varies very greatly according to the heat treatment. C. A. S.

1645. Electromagnetic Fields due to Variable Electric Charges and the Intensities of Spectrum Lines According to the Quantum Theory. G. A. Schott. *Roy. Soc., Proc.* 139. *pp.* 37–56, *Jan.* 2, 1933.—A rigorous method is developed of calculating the electromagnetic fields of variable electric charges on classical electromagnetic theory, avoiding such assumptions for the spatial extent or rate of variation of the electric distributions as limit the applicability of existing point charge formulæ for potentials and forces and the Liénard expression for the radiation. The resulting formulæ are applied to simple Schrödinger distributions to calculate their distant fields and energy radiation. The expressions thus obtained for the intensities of the Lyman, Balmer and Paschen lines and the numerical values calculated from them show that the usual determination, in the absence of a complete quantum theory of the electromagnetic field, of the electric moment of a distribution by Schrödinger's integrals, or an equivalent method, and applying the classical expression for the radiation from a dipole of equal moment, is liable to lead to serious errors. N. M. B.

1646. Cross-Sectional Effect of Magnetostriction. W. Fricke. *Zeits. f. Physik*, 80. 5–6. *pp.* 324–341, *Jan.* 31, 1933.—A method is described for determining the change of cross-section of a cylindrical rod of a ferromagnetic subjected to a magnetic field parallel to its length. The changes in cross-section are made to vary a capacity and the value of the latter is determined by a high frequency method. The intensity of magnetisation of the specimen was also determined. Measurements were made on iron, nickel and cobalt. All three metals showed magnetostriction hysteresis, but the latter appeared to show no simple relation with the ordinary hysteresis. For nickel the measured saturated magnetostriction agreed well with the value calculated from Becker's formula which is based on the Weiss-Heisenberg theory of ferromagnetism. W. S. S.

1647. Propagation of Large Barkhausen Discontinuities. Part III. Effect of a Circular Field with Torsion. L. Tonks and K. J. Sixtus. *Phys. Rev.* 43. *pp.* 70–80, *Jan.* 1, 1933.—The propagation of large Barkhausen discontinuities along a nickel-iron (15Ni 85Fe) wire which is under tension alone is practically unaffected by the presence of a large circular field caused by a current through the wire, but such a circular field creates large effects if the wire is twisted. Critical field characteristics were obtained from which a simple relation was found between the strain applied to the wire and the critical field. The component of the field perpendicular to that principal strain axis along which the extension is a maximum has no effect on the reversal of magnetisation. Thus this principal strain axis is a direction of preferred orientation of the magnetic domains in the strained wire. The magnitude of the critical field depends not only on strain magnitude but also on another unknown factor. Hysteresis curves taken with constant circular field show in some cases negative coercive force and negative remanence. A " hysteresis " curve of longitudinal magnetisation as a function of circular field, taken in zero longitudinal field, was a closed symmetrical loop with a large discontinuity in each branch. J. J. S.

1648. New Methods for Magnetic Measurements upon Thin Metallic Strips. P. C. Hermann. *Zeits. f. techn. Physik*, 14. 1. *pp.* 39–44, 1933.—The new method is designed to furnish data for the degree of magnetisation by direct current, as also the various quantities pertaining thereto, *viz.*, initial permeability, remanence, coercive force, hysteresis curves, etc., and also to utilise for the tests the smallest amount of material necessary. The shaping of the test piece and the work involved in testing must be reduced to a minimum, and there must be no perceptible influence upon the characteristics of the test piece by cutting or otherwise handling it mechanically. The accuracy of measurement is sufficient to satisfy all practical requirements. The method consists essentially of the suspension of the disc of metal to be tested in a field which can be calibrated by a special device described in the text, which consists essentially of balancing the effect of a direct current through a coil against the magnetisation of the test-piece. The magnetic qualities of a thin disc of ferromagnetic material are thus measured by a special circuit controlling the movement of the current-carrying calibration or balancing strip and coil. For field measurements the sensitivity of the method is such that the spot moves over the scale through 45 mm. per oersted, when the scale is at a distance of one metre from the mirror, and the auxiliary current has a value of 50 *m*A. The results of measurements are compared with those for the same material obtained by the ring method, and the magnitude of the errors in field measurements, etc., are thus determined. The agreement is fairly good, the maximum variation being at about 0·07 gauss. The differences may be partially attributed to the variability of the material itself, especially when a small thin disc is selected from a mass. S. G. B.

See also Abstracts **1331**, **1429**, **1430**, **1596**.

MEDICAL RADIOLOGY AND ELECTROLOGY.

1649. Investigation of the Gaseous Decomposition Products of X-Ray Films. Grace Ballard. *Radiology*, 20. *pp.* 18–28; *Disc.*, 28–31, *Jan.*, 1933.—Owing to a serious disaster in Cleveland, U.S.A., the question as to the spontaneous combustion of X-ray films, having a celluloid base, has become of importance. The present paper is chiefly of a chemical nature, and previous work by various investigators as to the decomposition products of celluloid films is reviewed. The present investigator has limited her work to the chemical determination of the amount of hydrocyanic acid which may be liberated on combustion of films with a nitrocellulose base and " safety " films, having a cellulose acetate base. As a result of the detailed investigations it is found that hydrocyanic acid is liberated on combustion, but the actual amount present, under practical conditions, may be dependent upon the amount of air present during combustion. Greater amounts are liberated by nitrocellulose films, as compared to acetate films. Acetate films require a much higher temperature for ignition and burning than nitrocellulose films and, whereas, when combustion has commenced, nitrocellulose films undergo exothermic combustion and continue to burn, acetate films undergo endothermic combustion and will not continue to burn, without application of further heat energy. Acetate films are therefore obviously preferable. In the *Discussion*, **P. C. Seel** referred to similar work carried out in the Eastman Kodak Research Laboratory, and, although the author's work is critically discussed, these results are mainly in agreement; **H. B. Podlasky** also expressed the value of films with an acetate base. B. J. L.

1650. Ultra-Violet Solar Radiation Measurements. W. W. Coblentz, R. Stair, and J. M. Hogue. *Bureau of Standards, J. of Research*, 10. *pp.* 79–88, *Jan.*, 1933.—In the present paper a description is given of the calibration of a selective photochemical, ultra-violet dosage intensity meter against a balanced thermocouple and filter radiometer, used as a standard. Data are given of the ultra-violet intensities of solar radiation in various localities at various elevations at various stations in Europe and upon the ocean. The measurements show a high ultra-violet reflection from clean fresh snow. The ultra-violet intensities over the ocean are not conspicuously higher than at a sea-level, dust-free station on land at the same latitude and the same season of the year. AUTHORS.

1651. Transient Peak KV and R Output from an Air-Cooled Therapy Tube. M. J. Gross. *Radiology*, 20. *pp.* 14–17, *Jan.*, 1933.—In air-cooled therapy tubes, during first operation, a change of emitted radiation occurs, although the conditions of operation, as regards voltage and tube current, are kept constant. A practical error of dosage can thereby occur, as great as due to an actual variation of the voltage of operation amounting to 12 KV and 15% of the administered dose. This change is due to a number of factors, chiefly variation of temperature of the glass tube and the air circulation around the tube. The transient phenomenon does not occur with water-cooled tubes. The period of variation may amount to 10 min., after first operating the tube, and is most marked with soft glass, rather than pyrex glass, but does not occur with constant potential operation. The theory of the variation is discussed and is due to the glass being negative with respect to the anode and so acting as a grid, which increases the space charge within the tube and modifies the current wave, unless the tube is operated by constant potential. The effect is not present if the tube is previously heated in an oven prior to operation. The same effect may occur in a kenotron valve, but is overcome by the cylindrical anode completely surrounding the anode-kathode space. B. J. L.

1652. Radium as a Therapeutic Agent. Lee of Fareham. *Brit. J. of Radiology*, 6. *pp*. 7–24, *Jan*., 1933.—Contains a general account of the present position of radium treatment of malignant disease, the work of the Radium Commission and the relative positions of radium treatment and surgery. Emphasises the dangers of indiscriminate use of radium such as occurs in radium waters, ointments and the like, and stresses the importance of radium being subject to Government control. G. E. B.

OSCILLATIONS.

1653. Dispersion of Undamped Ultra-Short Waves. M. Seeberger. *Ann. d. Physik*, 16. 1. *pp*. 77–99, *Jan*., 1933.—Measurements were made of the refractive index and of the absorption of a number of liquids for ultra-short waves of wave-length 12·6, 13·6, 14, 19 and 24 cm. Four methods were investigated and are described. Of these, two gave more accurate results and were employed in the major part of the work. For water and solutions in water of NaCl, $CuSO_4$, $ZnSO_4$, $Pb(C_2H_3O_2)_2$ and dextrose using 14 cm. waves, it was found that at room-temperature the refractive index was, within the accuracy of the measurements, independent of the concentration and equal to that of water ($n = 8{\cdot}75$). The absorption was found to increase with the concentration of the solutions. The corresponding values of the dielectric constant were calculated. Measurements were also made of the temperature coefficients of the refractive index, the absorption and the dielectric constant. Anomalous dispersion was observed with water between $\lambda = 12{\cdot}6$ and $\lambda = 19$ cm., with glycerin between 12·6 and 14 cm. and with propyl alcohol between 12·6 and 24 cm. An investigation was made of the dependence on frequency of the dielectric constant of propyl alcohol and the behaviour of the index of absorption was combined with the results of Eckert, Drude and Potapenko to cover the range from 1 to 74 cm. At 49° C. glycerin shows a pronounced maximum absorption for waves of 12·6 cm. The linear relation found by Bock between the temperature of maximum absorption and the logarithm of the wave-length was found to hold good for 12·6 cm. waves. For water, using 12·6 cm. waves, a marked decrease of absorption with increasing temperature was observed in the interval from 15° to 50° C. A. W.

1654. H.F. Voltage Diagrams. U. Bab. *Zeits. f. techn. Physik*, 14. 1. *pp*. 18–20, 1933.—Obtains h.f. curve-shapes by observing a Braun tube in a rotating mirror and adding a sine voltage differing slightly in periodicity. The Lissajou figures which would be generated if the two

periods were equal, go through a cycle of changes which are drawn out sideways by the same rotating mirror. The result is a bright curve on a lightly more luminous background, sufficient for a general orientation.
E. E. F. d'A.

PHOTOELECTRICITY.

1655. Photoelectric Effect of Electric Spark Radiation. J. Meiklejohn. *Phil. Mag.* 15. *pp.* 146–163, *Jan.*, 1933.—Experiments were carried out with the object of determining by means of a photoelectric photometer how the intensity of the radiation emitted by an electric spark varies with the potential difference of the spark electrodes and with the quantity of electricity discharged in the spark. The results obtained indicate that the intensity of the photoelectric radiation and the quantity of electricity discharged from single sparks were both quadratic functions of the minimum sparking potential. These three quantities depend on the physical and chemical nature of the electrodes used. The variations in the quantities for electrodes of the same shape follow the order, carbon, bismuth, aluminium, zinc, copper, lead, iron, with certain exceptions. The effect of the electrode substance tends to confirm the photoelectric theory of sparking potentials. E. E. F. d'A.

1656. Photoelectric Currents in Gases between Parallel Plate Electrodes. L. A. Young and N. E. Bradbury. *Phys. Rev.* 43. *pp.* 34–37, *Jan.* 1, 1933.—Describes a theoretical investigation of the passage of photoelectrons between parallel plate electrodes through a gas and the effects of varying the accelerating potential difference, the pressure and the gas are discussed. It is concluded that Ramsauer scattering in the immediate vicinity of the emitter is of importance. By the use of the derived formulæ it is possible to calculate the Ramsauer cross-section of the gas from the observed current. The ratio of this current to the saturation current is calculated, and is found to be in good agreement with the experiments upon hydrogen and nitrogen by Bradbury [see Abstract 4564 (1932)]. J. E. R. C.

1657. Optical and Photoelectric Investigations of Thin Metallic Films. R. Schulze. *Phys. Zeits.* 34. *pp.* 24–38, *Jan.* 1, 1933.—The theoretical treatment of optical phenomena at thin metallic films leads to a form of equations which represents an extension of those hitherto used. This extension is indispensable if the effects of multiple reflection and interference are to be taken into account. A new method of obtaining free gold films is described, and optical methods for determining the thickness of the films are given. The values obtained for the refractive index and the extinction coefficient follow well on those obtained by Meyer and Hagen and Rubens. Photoelectric measurements make it possible to calculate the absorption coefficient and the mean free path of the photoelectrons released. These two quantities are found to be independent of the wave-length and have the values $0{\cdot}32 m\mu^{-1}$ and $3{\cdot}12.10^{-7}$, respectively. An explanation is also given of the varying results obtained earlier by other experimenters.
H. L. B.

1658. Existence of a Blocking-Layer Photoelectric Effect in Galena. E. Tiede and G. Brückmann. *Zeits. f. Physik,* 80. 5–6. *pp.* 302–304, *Jan.* 31, 1933.—The authors have failed to discover any sign of a blocking layer in connection with a PbS film, even a transparent film, which might be expected to show the *Hinterwand* effect. The photoelectric effect seems in this case to be purely thermal. E. E. F. d'A.

1659. Measurements on Blocking-Layer Rectifier Photoelectric Cells. W. Meyer and A. Schmidt. *Zeits. f. techn. Physik,* 14. 1. *pp.* 11–18, 1933.—The authors adopt the scheme proposed by Schottky and Deutschmann for a rectifier photoelectric cell according to which it may be represented by a resistance followed in series by another resistance in parallel with a capacity. They give a mathematical theory of such a cell, and describe a Wheatstone bridge arrangement for measuring separately each of the resistances and the capacity. These measurements were made on copper oxide rectifier cells, a cupric iodide cell and a selenium rectifier cell. No essential differences were found between Se and CuO, but CuI_2 has to be placed in a separate class. The thickness of the blocking layer is, according to them, 10^{-4} to 10^{-5} cm., which is greater than the 10^{-7} assumed by Teichmann. They find no evidence for the view that the discharge is limited to a few points within a larger surface. E. E. F. d'A.

1660. Dependence of Rectifier Photoelectric Cells upon Luminosity and Wave-Length. A. Goldmann and M. Lukasiewitsch. *Phys. Zeits.* 34. *pp.* 66–73, *Jan.* 15, 1933.—Find the potential of a rectifier photoelectric cell of the cuprous oxide type expressible by $V = M/(L - MN)$, where L is the illumination and M. and N. are constants. In a particular cell this formula became $V = 0{\cdot}0662\ V(L - 2068)$ volts. Experiments with monochromatic light of various regions showed that the potential is practically independent of the wave-length. E. E. F. d'A.

1661. Dependence of Rectifier Photoelectric Cells upon Luminosity and Wave-Length. A. Goldmann. *Phys. Zeits,* 34. *pp.* 74–75, *Jan.* 15, 1933.—The voltage obtained in selenium rectifier cells on illumination is governed, like that of cuprous oxide rectifier cells, by the formula $V = ML/(L - MN)$ [see preceding Abstract]. E. E. F. d'A.

1662. Theory of the Crystal-Photoelectric Effect. H. Teichmann. *Roy. Soc., Proc.* 139. *pp.* 105–113, *Jan.* 2, 1933.—If opposite sides of a crystal of a semi-conductor (cuprite, proustite, pyargyrite), which is being traversed by light, are connected together through a galvanometer a photoelectric current is produced such that the electrons in the semi-conductor always move in the direction of the incident light ; the current can be measured without applying an acceleration potential. H. Dember has given the name " crystal-photoelectric effect " to this phenomenon to distinguish it from other photoelectric effects, especially from the " blocking-layer " photoelectric effect. The latter is caused by photoelectrons excited near the boundary between a semi-conductor and a metal and is explained by the unipolar conduction of the contact [see also Abstract 2993 (1932)]. A detailed discussion of the model of a potential hill within a substance shows that the quantum-mechanical model of the semi-conductor suggested by Wilson accounts for the existence of the crystal photoelectric effect in single crystals. The theoretical consequences are in good agreement with the experimental results. H. L. B.

1663. Amplifier for Photoelectric Cells. G. A. Boutry. *Comptes Rendus,* 195. *pp.* 1384–1387, *Dec.* 27, 1932.—Describes an amplifier permitting an amplification of 90,000 to be applied to a photoelectric current of 10^{-9} ampere. The amplifier contains one ordinary triode with an amplifying factor of 20 and one screened-grid valve. **Errata,** *ibid.,* 196. *p.* 144, *Jan.* 9, 1933. E. E. F. d'A.

See also Abstracts 1521, 1596.